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Confidence in Stability Of Metal Prices Returns

MAJOR non-ferrous metals—copper, lead, and zinc—have done remarkably well during the summer months. Following the collapse of the NRA structure late in May, many identified with marketing metals were prepared to weather a protracted period of readjustment. Not much was expected in the way of a revival in business until fall. The question that could not be answered three months ago was: "Would production under the changed conditions be held down so that surpluses could be reduced further where necessary?"

What occurred since the beginning of June has become history. The month of June turned out to be a dull period, with much price unsettlement. July saw evidence of a slow return in confidence, based in part on the production returns for June, which heralded the fact that output was being maintained at about the same rate as in May. August witnessed an excellent sales volume in copper, lead, and zinc, with the price-trend upward. Statistics issued during August confirmed what the July figures had foretold.

Prices were at depression levels, in many instances below cost of production. To step up production under such circumstances would have been little short of ruinous to all concerned and perhaps open the door wide for future drastic experimentation in economic planning.

Business volume, as numerous indexes now clearly reveal, underwent steady expansion, moving into new high ground for the year late in August. Consumers of non-ferrous metals, well aware of how producers are situated, sensed that the picture was gradually changing. They were facing a "sellers' market," or, to put it another way, the seller could dictate the terms.

Under code operation, particularly in copper, invisible supplies of metals were greatly reduced. The copper code tended to regulate the price as well as restrict purchases by fabricators to actual current needs. The net result was that consumers operated on a hand-to-mouth basis and kept reserve supplies at a low level.

The extraordinary buying of copper that took place last month, involving 69,000 tons in a single day, was not looked upon with favor in the industry, for it reminded many of the feast and famine periods of not so long ago. However, it appeared certain that the price would advance, and consumers just could not resist. Perhaps, when prices get back to a more natural level, and price movements can be held within reasonable limits, and purchasing agents realize that over a long period precious few have ever been able to beat the market, the buying waves may shrink to the size to which the lead and zinc producers have long become accustomed.

Statistically, the position of copper in this country has been improving. The "confidential" statistics of the Copper Institute reveal that 263,000 tons of refined metal were on hand at the end of July, a reduction of about 75,000 tons since the end of January, 1935. The statistical position of copper in the United States was at its worst in 1933, when more than 700,000 tons was on hand.

Stocks of refined lead in this country are regarded as too high, 230,000 tons, but the surplus is in strong hands, and, with consumption again pointing upward, the outlook for lead is better than the cold undigested figures indicate.

The zinc surplus in the United States is low, compared with both copper and lead, the total on hand being around 115,000 tons. The industry is greatly pleased over increased activity in galvanizing plants, for galvanizing accounts for more than 42 per cent of the total consumption of zinc in this country.

Rearmament unquestionably accounts for some of the world-wide activity in non-ferrous metals, but so far as this country is concerned, the uplift has a broader base. General business has been expanding, which accounts for most of the increased buying of copper, lead, and zinc.

Federal Legislation Affects Mining Industry

PRESSING his reforms on a politically obedient Congress, the President saw the major items in his program enacted into law during the closing days of a session that will live long in history. Of direct interest to the mining industry are the new laws relating to labor relations, bituminous-coal control, social security, and taxation. These are typical of new federal policies that reflect the philosophy of the New Deal, and which, if sustained by the courts, will inject new elements into the whole economic system of the country. Business will watch with some apprehension the effect of these policies, which are hailed by their advocates as the means of salvation and condemned by their opponents as deterrents to industrial recovery.

Labor relations under the Wagner Act will be experimental in the highest degree. Designed to "promote equality of bargaining power between employers and employees," the law imposes inequitable restrictions

on the former. Intended to "diminish the causes of labor disputes," it gives to organized labor a degree of power that can easily lead to more bitter disputes than industry has known. An all-powerful National Labor Relations Board will settle controversies. The bituminous-coal legislation is a "little NRA" for that industry. Urged on Congress by the President in spite of its possible unconstitutionality, it may become a pattern for the regulation of other natural-resource industries. Social security—old-age pensions and unemployment insurance—recognized as desirable and inevitable, will add to the cost of doing business and must be taken into consideration immediately. Finally, taxation looms large on the horizon, as the cost of the depression and social reform reveals its generous proportions. The campaign against "bigness" finds expression in two principles of punitive taxation—sliding scales on corporation incomes and levies on dividends received from subsidiaries. All told, the trend of legislation has been toward concentration of federal power to control and regulate business. Many of the measures must stand early test of legality, and the whole program has yet to be submitted for popular approval. A lively and interesting year lies ahead.

Nickel—Munition or Industrial Metal?

SOMETIMES an early reputation persists embarrassingly long and can be lived down only by dint of special effort to create a new one. Thus with nickel. Having been tarred with the stick of munitions of war, when it served that purpose well, it continues to be regarded in that guise in spite of more diverse and expanded peace-time uses. All of which leads Mr. Robert C. Stanley, president of International Nickel, to address his shareholders on the subject. He would impress the public with the fact that "there has been a significant change in the world nickel industry during the last fifteen years," and he wants to obliterate the impression that the company is "trafficking in a war material."

We sympathize with Mr. Stanley's desire to gain for his company's product a more benign reputation, and hasten to pay our tribute to nickel as one of the most versatile of alloying metals. In fact, we publish in this issue some information on alloy steels for the mining industry, citing some important uses of nickel steel. And in a second article we give a more extended discussion of industrial uses of nickel—in transportation, communication, and a host of manufacturing industries. A claim can justly be made for nickel as a peaceful factor in modern industrial civilization, due, incidentally, in great measure to the research and development activities of Mr. Stanley's company.

But the munitions aspect cannot be wholly wiped out of public consciousness, any more for nickel than for chemicals and other industrial products. So long as metals are unequally distributed in the earth and subject to political control, just so long will we have the problem of national mineral policies with respect to "strategic" or "deficient" metals. And emphasis on that problem will be made first, not by peace-time industrialists, but by those charged with national defense. Nickel is a "strategic" metal in the United States, for which reason we publish the second of the two articles referred to above. It portrays a regrettable national dependence on outside sources of nickel, whether for munitions or industrial products.

Loose Talk About Silver

WHEN it comes to the monetary metals, the eyes of the world are on the United States because the policies of our Government are largely responsible for the enhanced prices of gold and silver and for the speculation regarding their future. Particularly acute is the dilemma regarding silver and the workings of our Silver Purchase Act, which became law on June 19, 1934. The subject has been productive of numerous articles in the technical, financial, and daily press and the general magazines. It has brought forth pamphlets, letters, speeches, and economic and political arguments in great volume. And the problem is as puzzling as ever.

Some of the talk is obviously loose and uninformed. The article in *Collier's* for July 6, for example, which brought a spirited and reasonable protest from Leo J. Hoban, secretary of the Hecla Mining Company, of Wallace, Idaho. Mr. Hoban criticized the article in a letter to the editor of *Collier's* and, after waiting a respectful period for an acknowledgement that didn't come, made his letter public. We shall not detail Mr. Hoban's disclosure of factual errors in *Collier's* article, particularly with reference to the Pittman Act. Suffice it to say that he was on solid ground and cited official documents in support of his position. Also he pointed out that, whatever the merits or demerits of the Silver Purchase Act, "it is in refreshing contrast to the payment of taxpayers' money for hogs, cotton, and wheat never produced."

Recently the Tobacco Producers Association made public a letter to the President regarding the deplorable state of our tobacco trade with China, attributing the difficulty to the Government's silver policy. The facts about tobacco are probably correct, but the producers are less secure in their comments on mining. They allege that our silver policy has been of no benefit to the miner; in fact, has been a detriment, because it has stimulated production of the base metals that are already low in price. Unfortunately, they selected the copper industry as the terrible example of the evil effects of the silver policy. Whatever the wisdom or folly of that program, the fact remains that domestic silver producers have benefited from the higher price for newly mined metal.

Reverting to Mr. Hoban's letter, we agree that "there is an honest difference of opinion as to the value of the use of silver as money," also plenty of room for argument on the economic and monetary aspects of the silver policy. In this we have declined to participate, feeling that the whole matter is so definitely in the lap of the political gods as to make argument futile. As for the mining industry, what happens to silver is *relatively* unimportant compared with early industrial recovery that will provide a profitable market for copper, lead, and zinc.

Producing Lead at the Galena Smelter From Tri-State Concentrates and Battery Scrap

R. L. Hallows
Manager

B. M. O'Harra
Metallurgist

Eagle-Picher Mining & Smelting Company, Galena, Kan.

- Scotch hearths, blast furnace, and reverberatory in service
- Refinery practice has unusual features, due to the character of materials treated and the need for meeting special requirements of the Eagle-Picher company's works at Joplin
- Flotation is employed for recleaning jig concentrates to provide the raw material required in the basic sulphate plant

NEAR Galena, Kan., and about 5 miles west of Joplin, Mo., is the Galena smelter of the Eagle-Picher Mining & Smelting Company. The principal lead-containing materials treated at it are lead concentrates from the Tri-State district and battery scrap from surrounding territory. It also resmelts some lead waste and byproducts returned from the Joplin plant of the Eagle-Picher Lead Company.

The Tri-State mining district is famous chiefly for its zinc output, but it also furnishes normally about 10 per cent of the United States lead production, most of which, in recent years, has been smelted at the Galena plant. The lead concentrates are remarkably pure, containing virtually no arsenic, antimony, tin, bismuth, or silver. From 0.01 to 0.1 per cent of copper occurs in the concentrates as chalcopyrite. Iron is present in amounts varying between 0.5 and 6 per cent, largely as marcasite. The chief impurity affecting the smelting of the concentrates is zinc as blende.

Lead content of the concentrates received by the smelter averages about 78 per cent. This material consists largely of coarse jig product, with some table concentrates, and hand-picked lead ore containing up to 80 per cent and more of lead and a minor amount of flotation concentrates running down to less than 60 per cent lead. The zinc in the concentrates increases as the lead decreases.

The coarse concentrates provide an ideal feed for ore hearths, giving a high direct yield of lead. Flotation concentrates, on the other hand, on account of their low lead and high zinc content, give a low direct yield of lead. However, the tonnage of float concentrates received at Galena is not sufficient to justify a separate method of treating them, so they are charged to the ore hearths along with the coarse concentrates.

Inasmuch as all zinc in the concentrates eventually finds its way to the blast furnace in gray slag from the ore hearths, and as the concentrates do not contain sufficient fluxing material to carry the zinc in the blast furnace slag, the amount and kind of fluxes added at the blast furnace are chiefly determined by the amount of zinc to be fluxed. Thus, the zinc content of the various grades of concentrates has an important bearing on the cost of smelting them.

As most of the lead produced at Galena is used at the Joplin plant referred to, for making litharge, red lead, orange mineral, and various manufactured lead products, the refining practice at Galena is varied as occasion demands to produce most economically the various grades of lead in amounts to satisfy the manufacturing plant's requirements. This circumstance, along with the fact that the refinery treats both lead from the remarkably pure Tri-State ores, and lead recovered from antimonial lead battery scrap, results in some unusual features in refining practice that are not found in most lead refineries.

The principal departments of the plant are the ore-hearth department, for smelting Tri-State lead concentrates; the battery-scrap smelting department; the blast-furnace department for smelting gray slag from the ore hearths, refinery skims, and various plant byproducts; the lead refinery; and a plant for the manufacture of sublimed white lead or basic lead sulphate. Sublimed blue lead is produced for market from special ore hearths.

In the ore-hearth department are eight mechanically rabbled Newnam hearths of standard design. These are arranged in a single row, end to end, extending the length of a building which includes raw-concentrate storage space, also running the full length, back of the hearths. Concentrates are received in box cars on a switch track parallel to this storage space and are unloaded onto the storage floor over a shuttle conveyor. At one end of the building is a jaw crusher for crushing lump galena, which, when crushed, is also handled over this conveyor.

Storage space for burned baghouse dust is provided at one end just outside of the building, and for coal and pulverized limestone outside the building at the other end and in front of the hearths. Extending along the front of the line of hearths, within convenient shovel reach of the furnacemen, is a series of small concrete bins or pockets, the bin in front of each hearth being divided into separate compartments for concentrates, coal, limetone, and flue dust.

The make-up of the charge is left largely to the judgment and experience of the furnacemen, who scatter the concentrates and other constituents over the hearth bed by shovel, determining the proportion of fuel and limestone by the type of concentrates being smelted

and the behavior of the charge on the hearth. The materials charged are brought from their various stockpiles to the small pockets in front of the furnaces by means of a gasoline tractor equipped with a Lessman loading shovel.

The gray slag from each hearth is taken off with a fork by the furnaceman, quenched in a portable container of water at one end of the hearth to cool it, and transferred in the container by electric tier lift forked trucks, operating on a system of overhead trolleys, to a hoist which discharges it into the blast-furnace storage bins.

Table I—Metallurgical Data on Hearths for Two Different Grades of Concentrates

	80% Pb Concentrates	60% Pb Concentrates
Per cent lead in concentrates recovered as metallic lead	85	50
Per cent lead in concentrates recovered as lead in gray slag	15	50
Per cent dry weight of concentrates as circulating fume	24	30
Per cent dry weight of concentrates of coal used	4	15
Per cent dry weight of concentrates of limestone used	2	12
Tonnage concentrates per 8 hearths per 24 hr	225	125
Tonnage gray slag per 8 hearths per 24 hr	60	90
Tonnage lead per 8 hearths per 24 hr	150	35

Lead produced in each ore hearth is drawn off through a lead well into a small drossing pot at the opposite end of the hearth from the gray slag container. Dross is returned to the hearth. From the drossing pot the lead overflows into a block mold holding approximately 2,500 lb. When the mold is full, an iron hook is allowed to freeze into the block. The block is lifted out of the mold and transferred to the lead refinery or to a storage yard by the same electric lift trucks that handle the gray slag. The shape of the cast block is such as to allow the fingers of the lift truck to slip under it while it is resting on the floor. Each block is weighed and marked before leaving the ore-hearth building.

The crew of the hearth-smelting department consists of one foreman, eight smeltermen, one tapper, one sweeper, and two bagroom attendants. On alternate days a tractor driver is employed to remove burnt flue dust from the bagroom. Two trail cleaners are employed on the day shift.

Fume from the hearths is drawn off through overhead balloon flues, thence through inverted U-tube cooling flues, and to the baghouse.

Two of the hearths are connected to a separate flue system. The charge to these hearths and the manner of operation are regulated with particular attention to the production of fume having the color and other properties required for marketable sublimed blue lead. This product is collected in special compartments of the main baghouse and packed and barreled for shipment.

The entire baghouse serving the ore hearths, including the compartments used for sublimed blue lead, contains 2,109 bags, 18 in. in diameter by 29 ft. long. The baghouse is connected to a 257-ft. concrete stack. Baghouse dust is burned on the floor, the product being removed to a storage bin with a gasoline power shovel.

Lead battery scrap is received in box cars, from which it is unloaded by wheelbarrow into a subsurface storehouse (90x36 ft.) having 2,000 tons' capacity. Most of the scrap is purchased on a clean dry basis. A sample of several thousand pounds is taken by shovel as each car is unloaded. This is quartered down to about 200 lb. and the 200-lb. sample is heated in a small kettle, mounted on a scale, to a temperature sufficient to drive off all moisture and burn any wood or rubber in it. From the sample weight before and after this treatment the clean dry weight of the shipment is calculated.

Scrap is smelted in a reverberatory furnace 42x9 ft. in horizontal section, inside dimensions, fired by natural gas and housed in what is known as the Brett-Doyle furnace building. In this installation the furnace is built inside a riveted steel pan, with all seams welded to be lead-tight. The pan is lined with 18 in. of firebrick, with magnesite brick at the slag line. The arch is of 9-in. firebrick and high alumina brick. Main burners are at one end, with some auxiliary burners along the side.

Operation of this furnace is continuous. That is, it is charged continuously at the burner end, lead and slag being drawn off near the flue end at frequent intervals to maintain the bath approximately at constant level. The depth of the bath at the center line of the furnace is approximately 15 in. The scrap, mixed with a small amount of fine petroleum coke breeze, is transferred from the storage house by an inclined belt conveyor which discharges into a chute opening in the top of the furnace at the center line next to the burner end between the two main gas burners. Cars of scrap on the track are unloaded directly on the incline belt feeding the furnace. Refinery skims, waste from the sublimed white lead plant, and other byproducts are sometimes charged along with the battery scrap. A motor-driven water-cooled reciprocating pusher, projecting through the end of the furnace, pushes the unsmelted material out from under the furnace charge chute and it floats down toward the flue end of the furnace, being melted by the time it arrives there.

Table II—Average Analyses of Hearth Products

	Gray Slag	Baghouse Fume	Burnt Fume
$PbSO_4$	6.6	55.6	64.5
$PbSO_3$	....	4.6	0.2
PbO	22.9	32.9	33.0
PbS	27.7	4.1	0.2
ZnS } ZnO }	14.2	1.6	1.7
CaO	10.1	....	....
Insol.	7.4	....	....
FeO	8.6	....	....
MgO, Al_2O_3, CdO, C.	2.5(a)	....	....
FeO, CdO, Insol., Volatile, C	....	1.2(a)	0.4(a)

(a) By difference.

Lead-antimony oxide slag, containing 12 to 18 per cent antimony and 55 to 70 per cent lead and practically all the tin and arsenic in the charge, overflows through a water-jacketed spout at one side of the furnace at the flue end into small slag pots. The flow is not continuous but slag draws are made at frequent intervals. The pots of slag are pulled by hand to a cooling yard, and when cold are dumped, broken up, and loaded into box cars by a power shovel. The slag is smelted in a small cupola furnace at the East St. Louis plant of the Eagle-Picher Lead Company, for the production of antimonial lead alloys.

Lead is tapped from the furnace by means of a lead well into a drossing pot, from which it is tapped into blocks of the same size and shape as those produced from the ore hearths. The crude lead produced has approximately the following analysis before refining: Sb, 0.4 per cent; As, trace; Cu, 0.08; Bi, 0.05; and Sn, trace.

The reverberatory can produce approximately 75 tons of lead per day. Fume from the furnace is drawn through cooling flues to a 24-compartment Dracco dust collector containing 432 bags 117 in. long and 8 in. in diameter. The dust is pugged with a small amount of water to densify it and returned to the smelting furnace. It usually contains about 14 per cent antimony as oxide and about 55 per cent lead as normal lead sulphate.

Gray slag from the ore hearths, kettle dross and softener skims from the lead refinery, waste from the white lead plant, and other plant byproducts are smelted in the blast furnace.

The charge constituents, including fluxes, are stored in hopper-bottomed steel bins arranged in a row, under which is a track for the collecting weigh car. Beneath each bin is an apron feeder, actuated by a gear which engages with a motor-driven gear system on the collecting car. This car runs along under the bins and weighs the required amounts of the various constituents into itself, then dumps the complete charge into a skip, which, in turn, dumps it into the charge car on the blast-furnace charging floor. The charge

car is a bottom-dump car, pulled by a cable, which runs on a track over the top of the furnace.

The blast furnace is the standard 42x128-in. Traylor Engineering & Manufacturing Company furnace. In this furnace, the lead well is at one end, and overflows into a 10-ton drossing kettle and then into a 35-ton storage kettle, from which the drossed lead is pumped to the lead refinery.

At the opposite end of the furnace is the slag tap. Slag is tapped into a small settler, to entrap any lead carried over with it. No matte is produced. Slag from the settler overflows into slag pots, which are drawn by a gasoline locomotive to the dump.

Gases are drawn off through a hood over the top of the furnace. They are filtered in the same Dracco collector that is used for the battery-scrap smelting furnace. The blast furnace and battery-scrap furnace are not operated simultaneously, but run in alternate campaigns of several weeks each. Blast-furnace baghouse dust is pugged and returned to the furnace. Certain plant byproducts are smelted either in the blast furnace or in the battery-scrap reverberatory, according to which happens to be operating.

The normal capacity of the blast furnace is about 6 tons per 24 hours per square foot of area at the tuyeres. Coke used averages about 12 per cent of the charge weight.

Because of the considerable variety of materials smelted in the blast furnace, all of which have a high lead content and are likely to vary greatly in analysis, and the limited facilities for bedding these materials, the chemical composition of the blast-furnace charge sometimes varies considerably from the intended composition as calculated from the bin samples. For this reason it is customary to charge a rather large percentage of slag shells and return slag, to act as a balance wheel so as to prevent too large unexpected variations in slag analysis. This practice is open to criticism but is believed to be good economy under the circumstances.

Average lead fall is about 30 per cent. Following is a typical analysis of the slag produced: FeO, 30 to 33; CaO, 10 to 14; SiO_2, 25 to 30; ZnO, 16 to 20; and Pb, 1.5 to 3.0.

In the Lead Refinery

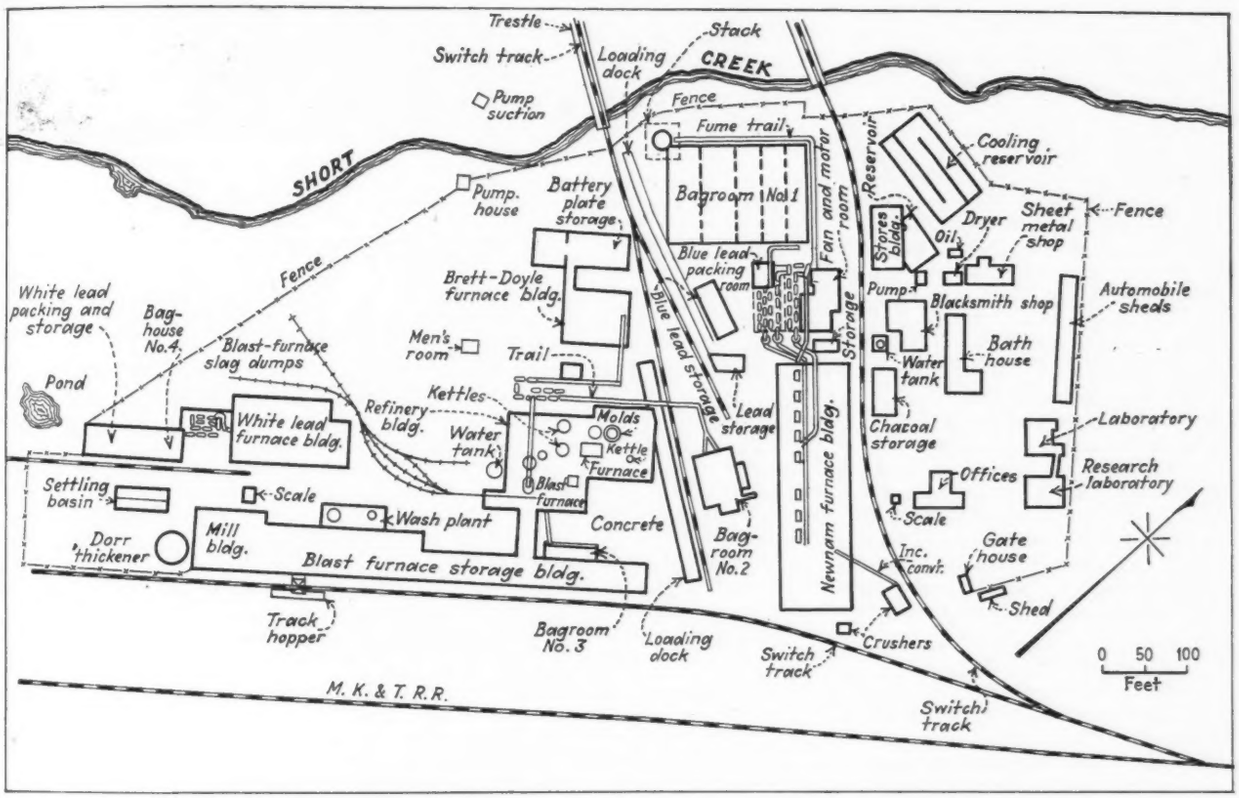
The refinery contains one 35-ton melting kettle, an 80-ton melting and zincking kettle, a 70-ton softening furnace, and an 80-ton molding kettle. There is also a 35-ton kettle with a separate set of molds for drossing and molding "soft Missouri" lead from the ore hearths which does not require further refining. An overhead traveling crane runs the entire length of the building.

The softener-dezincking furnace is built in a water-jacketed pan. It is firebrick throughout except for a magnesite slag line and measures 12x20 ft. inside.

As already stated, the refining practice is largely determined by the needs of the Joplin plant of the Eagle-Picher Lead Company for the various grades of lead which can be produced.

About one-third of the soft lead from the ore hearths is drossed and molded without further refining. Hearth lead of lowest copper content is chosen for this purpose. Following is a typical analysis of this lead after careful drossing: Sb, 0.0005 per cent; Bi, 0.0003; Cu, 0.015; Zn, 0.001; and Ag, 0.1 oz. per ton. The remainder of the hearth lead is treated with zinc to remove copper and produce corroding lead.

All blast-furnace lead and lead from the battery-scrap smelting furnace is treated with zinc to remove copper and refined to corroding lead. The zinc treatment is similar for lead from the ore hearths and for blast-furnace lead and lead from the battery-scrap furnace. The latter two contain some antimony, but this small amount of antimony causes no trouble in zincking. Inasmuch as the residual zinc remaining in the lead after the zinc treatment is removed by fire refining in the softening furnace,



THE GALENA PLANT of the Eagle-Picher Mining & Smelting Company covers an area approximately 1,200 ft. long and 600 ft. wide. It is situated just west of the Missouri-Kansas State line

it is more economical to leave the antimony in the lead until after the zinc treatment and then remove it with the zinc, rather than soften before zincking.

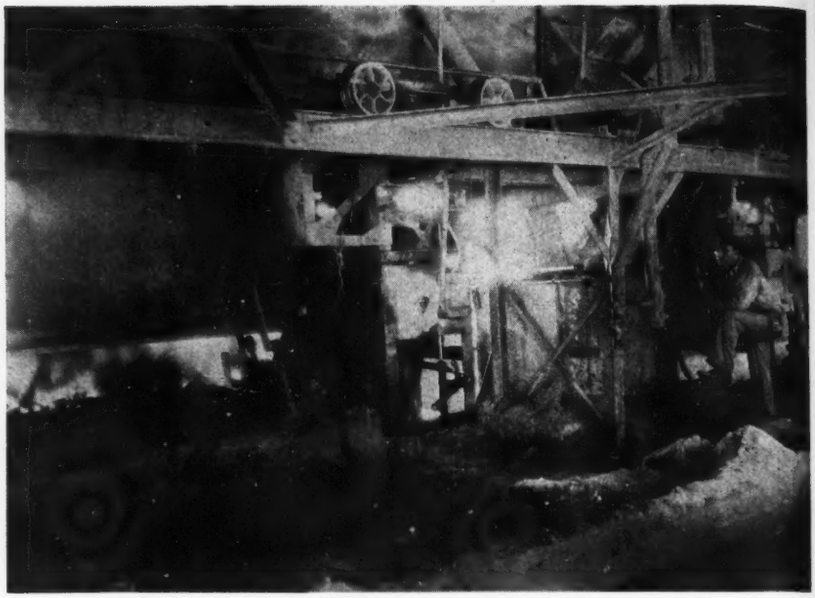
None of the lead refined contains appreciable amounts of silver, and the zinc treatment for removing copper differs considerably from usual desilverizing practice. Copper is removed from lead with zinc much more readily than silver. Whereas in desilverizing it is necessary to saturate the lead fully with zinc, so that, after desilvering, it contains about 0.55 per cent zinc, in removing copper much less zinc can be used, and the lead after decopperizing contains only 0.2 to 0.35 per cent zinc.

Scrap zinc is used almost entirely for the purpose, though a small stock of slab zinc is kept on hand as a reserve. The zincking procedure follows:

The 80-ton zincking kettle is filled with molten lead. (Blocks of cold lead from the hearths or battery-scrap furnace are either melted in the zincking kettle itself or are melted in the melting kettle and then pumped into the zincking kettle.) Included in the charge is the "cold skim" from the preceding zincking cycle. A preliminary dross or "mud skim" is removed and 1,000 lb. of zinc is then added and stirred in for about 30 minutes at a temperature of about 850 deg. F. Following is a typical analysis of the mud skim resulting from refining secondary lead: Zn, 1.5 per cent; Cu, 0.8; and Sb, 0.6.

A small amount of dross rises to the top of the kettle after the zinc is stirred in. This is dry and rather dusty, and can be skimmed off without entraining much lead. This dross from secondary lead refining analyzes: Pb, 55 per cent; Zn, 25; Cu, 1; and Sb, 0.7.

After this dross is skimmed off the kettle is allowed to cool. This may be hastened by running a stream of water on the surface of the kettle to freeze a chunk, and then submerging this chunk in the remaining molten lead. The zincky lead which rises to the top of the kettle during cooling is not skimmed off. Cooling is continued until a layer of zincky lead about 3 in. thick freezes over the top and for 6 in. to a foot down the sides of the kettle. Before the crust forms, a steel frame from which are suspended a number of hooks is lowered into the kettle until the hooks are partly immersed in the lead. The hooks are thus frozen into the crust. When the crust has reached the desired thickness, a crane picks up the steel frame and lifts the crust off the kettle and sets it to one side. This is the "cold skim" which is returned to the kettle with the next charge of lead. Quite frequently, two such skims are removed. The lead remaining in the kettle, which contains 0.20 to 0.45 per cent residual zinc, and whatever antimony was in the lead before decopperizing, is pumped to the softening furnace. The complete decopperizing cycle requires about eight hours.



EIGHT NEWNAM HEARTHS, of standard design, smelt the lead concentrates received at the Galena plant. One of these is seen at the left with its mechanical rabbling machine. Gray slag is removed with a fork by the workman, quenched in water, and sent to the blast-furnace storage bins

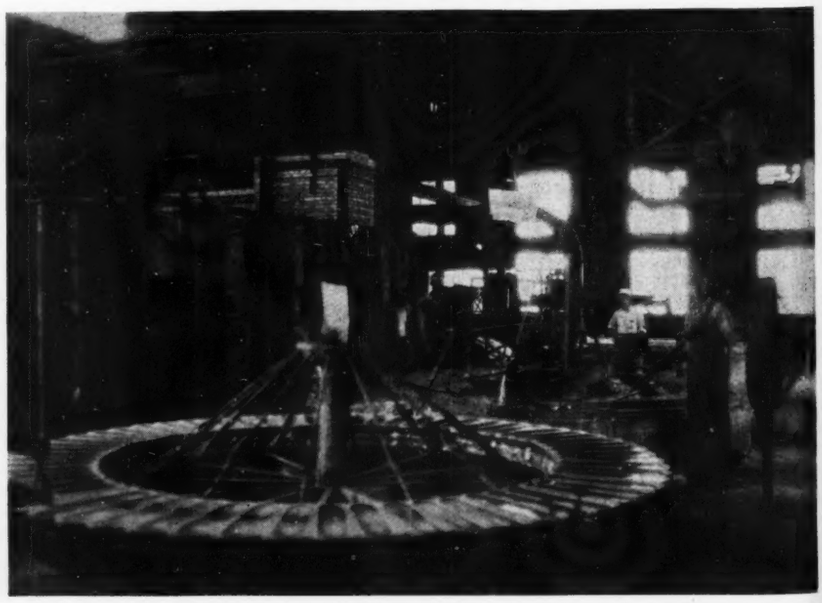
Practice in softening or dezincking follows closely usual lead refinery practice. The softening furnace is fired with natural gas. In lead from the ore hearths, containing no antimony, the zinc comes off as a skim averaging about 7 per cent of the weight of the lead charged, the following analysis being typical: Pb, 86 per cent; and Zn, 6 per cent.

In lead from the blast furnace or the battery-scrap smelting furnace, two skims are taken off the softening furnace. Typical analyses are: First skim —Pb, 73 per cent; Zn, 9.5; and Sb, 6. Second skim—Pb, 85 per cent; Zn, 2; and Sb, 3.

The lead refinery building also contains a furnace for liquating skims from the refinery, the battery-scrap furnace drossing kettle and the blast-furnace drossing kettle. It is used infrequently. Most of the time the skims are smelted in the blast furnace.

Skims from the drossing kettle of the blast furnace eventually become quite

IN THE LEAD REFINERY of the Galena smelter. Hung from the crane in the center is one of the 2,500-lb. blocks of lead received from the ore-hearth department. About one-third of the lead from the latter is simply drossed and molded here. The rest is decopperized with zinc to produce corroding lead.



rich in copper and are liquated and enriched in copper and sold in this form or are run through the blast furnace in a special copper concentration run for the production of copper matte.

As the amount of copper entering the Galena smelter is comparatively small, only a small amount of this coppery dross or matte is produced per year.

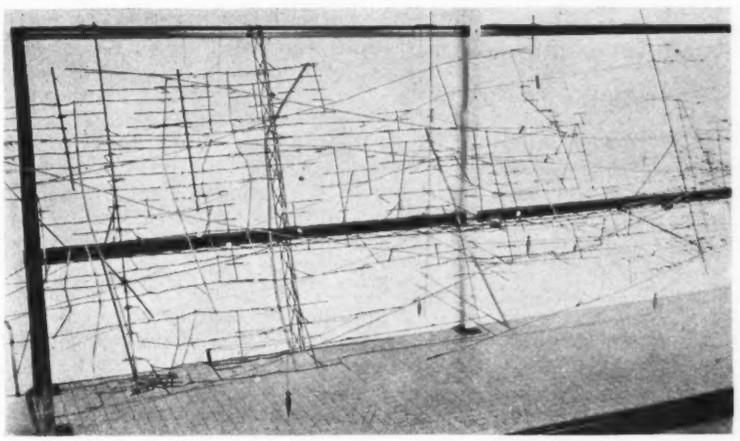
Raw material for making sublimed white lead is either refined lead or purified galena concentrates. Concentrates used for this purpose are practically chemically pure lead sulphide. They are produced by recleaning high-grade jig concentrates from the Tri-State district by further jigging and flotation, followed by leaching the recleaned concentrates with hot, very dilute sulphuric acid to dissolve off any impurities existing as a coating on the sulphide particles. The mill for producing these purified concentrates is situated alongside the sublimed white lead plant proper.

In the sublimed white lead plant these concentrates are dried and burned in a firebrick combustion chamber, being blown into the latter with air using a burner similar to a powdered coal burner.

Auxiliary heat and ignition are supplied by natural-gas burners. The lead sulphide is burned and volatilized to basic lead sulphate, the product being conveyed through settling flues and cyclone collectors to settle out impurities and coarse particles, the finished product being collected in a Norblo dust collector.

The process of making sublimed white lead from metallic lead is similar except that molten lead is atomized and blown into the combustion chamber, along with sulphur dioxide gas from a sulphur burner.

The sublimed white lead produced by either of these methods is very much superior to the product made by the old slag-eye process.



A Quickly Understood Model

L. D. Stewart
Montreal, Wis.

MINE MODELS usually do not mean much to people outside the mining fraternity. The non-professional is lost in a maze of detail and unable to visualize the relative proportions and actual extent of the mine openings. In an effort to overcome these difficulties and make a model of the Montreal mine from which the layman, as well as the mining engineer, could get something, I constructed the mine model shown in the accompanying illustration.

Round brass welding rod, $\frac{1}{16}$ in. diameter, was used throughout to represent drifts, crosscuts, raises, and even the outline of stoped-out areas. Rods $\frac{1}{8}$ in. thick were used for the shafts. Intrusive dikes and cross-faults were indicated by strips of copper sheet. These strips do not show the whole dike or fault but simply indicate the position and trend.

Each level was made from one of the regular blueprints prepared by the engineering department. The wire was laid on the print and bent and soldered to conform with the actual outline. The vertical location of the shafts and levels was taken from the regular cross-sections. In each direction the scale is 100 ft. to the inch.

The material encountered at a given place can be learned by referring to the legend color chart, as the rods representing the various openings have been enameled in color. The regular level number of each level is shown by attaching a flat-headed copper rivet upon which is printed the proper number.

To serve as a guide in determining the vertical elevation above or below sea level, a numbered scale was placed at the back of the model. The top of the table which holds the model was ruled and numbered with 100-ft. coordinates. In addition, the section lines, principal roads, the river, and other points of interest were drawn on the table top. From any opening underground, the correct surface location can be determined by dropping a small plumb bob down to the table top.

The model is of value geologically in that the footwall and hanging-wall dikes are shown in their relative positions, with nothing to obscure the vision. The intersection of eastward- and westward-pitching dikes, and the major cross-fault zones, can be seen at a glance. Projections of these structural relations have been carried below the present workings, providing an excellent means of forecasting the areas of probable ore concentration.

World Tin Output Up in First Half Year

ACCORDING to the August issue of the Bulletin of the International Tin Research and Development Council, published by The Hague Statistical Office, the world production of tin in the first half of 1935 was 51,071 long tons, compared with 50,753 tons in the first half of 1934. Of this year's output 40,306 tons, or 79 per cent, were produced by Malaya, Bolivia, Netherlands East Indies, Nigeria, and Siam, and 4,582 tons, or 9 per cent, were produced by the Belgian Congo, French Indo-China, Cornwall, and Portugal. British Malaya alone produced approximately 30 per cent of this year's output of tin.

The apparent world consumption of tin in the first half of 1935 increased by over 14 per cent, to 67,450 tons, compared with 58,959 tons in the first half of 1934. It is estimated that 27,800 tons of tin were used this year in tin-plate manufacture, against 25,400 tons last year; and 9,100 tons in the motor industry, against 7,560 tons.

Tin consumption in the following countries has already exceeded the level reached in 1929, Russia's present consumption being greater by 27 per cent, consumption in Egypt by 20 per cent, South Africa 20 per cent, Norway 9 per cent, Sweden 8 per cent, Holland 7 per cent, Greece 5 per cent, and Denmark 4½ per cent.

On Aug. 9 the International Tin Committee advised that tin production quotas would be fixed at 65 per cent for the third quarter of 1935. The committee will probably meet at the end of September to determine fourth-quarter production.

Gold Placer Mining Revived At Lincoln

Results show benefits of improved dredging and washing equipment, better geological knowledge and the higher metal price

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Draglines and scow-mounted washing plants prove adequate in working relatively small and shallow deposits near the Sierra Nevada foothills . . . Even bedrock is characteristic . . . The use of diesel engines reduces power costs

John B. Huttl
Assistant Editor

SINCE the exhaustion of the bonanza gravels worked by the Forty-Niner and others that followed, placer mining in California has become primarily a material-moving problem. Modern excavating methods and equipment have elevated it from a haphazard calling of the more adventurous spirits to an industry which demands technical and systematic attention. Today large masses of gold-bearing earth and gravel are moved by hydraulic giants where hydraulic mining is permitted, and, in the Oroville, Folsom, and Snelling areas, the extensive and deep placer deposits are worked by large gold placer dredges, some capable of handling 400,000 cu.yd. per month.

The relatively small and shallow placer areas near the foothills of the Sierra Nevada received little or no attention until the advent of the power shovel and dragline. Prior to this event the richer deposits were worked manually by Chinese, and then abandoned. Early attempts to exploit this type of deposit by mechanical means failed, mostly because of inexpert handling of the equipment, careless testing of the ground, and high power and water costs. For years this branch of placer mining languished, and it was not until 1933 that new interest stimulated by the enhanced price of gold brought about a substantial revival.

The benefits accruing to gold placer operations from the gold premium as well as from improved excavating and washing machinery and a better knowledge of placer geology are characteristically demonstrated by the results obtained in the Lincoln area during the past year. The operations I visited early in June, 1935, five in number, are all within a radius of 10 miles from the town of Lincoln, about 29 miles northeast of Sacramento, Calif. Many concerns have crews in the field testing unexplored ground, and several new plants are planned or in progress of construction.

The geology of the Lincoln placers is interesting. No two deposits are alike, the character of the bedrock and gravel varying according to location. Those near the foothills usually rest upon a bedrock of decomposed granite, while false bedrock of clay and volcanic ash, locally termed "lava ash," and well-cemented gravel are frequently encountered at deposits in the delta area proper. Another phenomenon is the presence of quartz particles impregnated with native gold. The distribution and size of the gold particles in the gravel also vary widely. Though the gold in general is fine—the largest particles seldom exceeding 50c. in value—nuggets of a value ranging from $1 to $4 have been found at a dry placer operation situated at quite a distance from the foothills. From the foregoing it appears that the Lincoln placer deposits, and those in neighboring districts to the north, in general belong to a modern stream system which in some cases has either captured bench deposits of Tertiary channels or may have been enriched by a portion of the main Tertiary channels near the foothills.

The gravels in the pay channels are fairly compact, and vary from 8 to 15 ft. in thickness, including a layer of topsoil from 2 to 4 ft. thick, and generally too poor to be washed in conjunction with the gravel. Testing of the ground is done by sinking test pits, usually one to each acre. Values contained in the gravels range from 25 to 75c. per yard. Working costs are from 12 to 16c. per yard. At the dry placer operation mentioned previously, costs average 25c. per yard. Water for operations is obtained from the Nevada Irrigation District, a maximum of 75 miner's inches being allowed each operator, though the average water consumption is about 35 miner's inches per operation. It is brought to the washing plant pond in shallow ditches and is seldom reclaimed, because of lack of storage facilities.

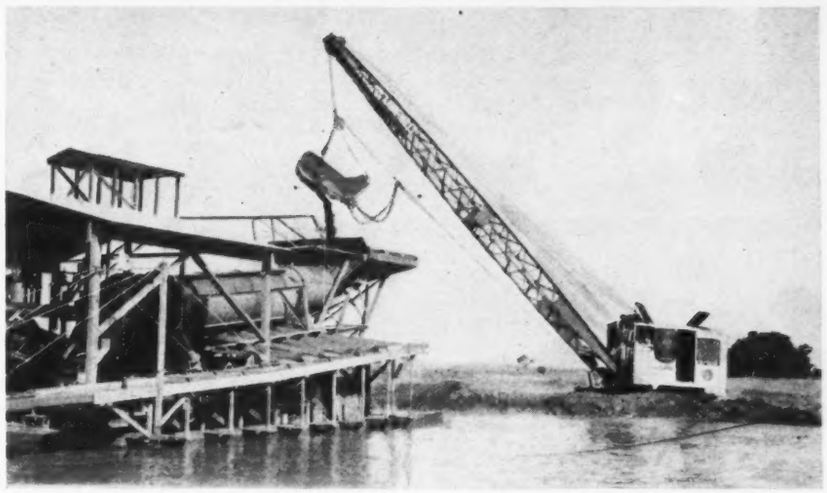
Equipment used for excavating and washing the pay gravel consists of the conventional dragline equipped with a 60-ft. boom and a 1½-cu.yd. Page-type bucket, and a portable washing plant. In view of the fairly even bedrock characteristic of the Lincoln placers, it was found best to mount the washery upon a shallow scow or hull, thus giving it the appearance of a small dredge minus the digging ladder. Though the operation of this equipment is not as continuous as that of a bucket-line dredge where the digging element works in complete unison with the gravel-treating machinery, a maximum daily average yardage can be produced with a digging unit and washing plant designed to meet the requirements as to bedrock and the character and size of the gravel.

Initial cost of the various plants in operation at Lincoln ranges from $22,000 to $25,000. Average capacity exceeds 150 cu.yd. per hour. Save for the hull, the newer washing plants are built of steel and contain many unique features involving late developments in screening and washing machinery. Moving and stepping ahead of the plant is accomplished by means of ⅜-in. steel shore lines attached to a series of hand winches on the mezzanine deck. The new plants soon to be erected are to have sectionalized steel hulls to facilitate transportation to a new location.

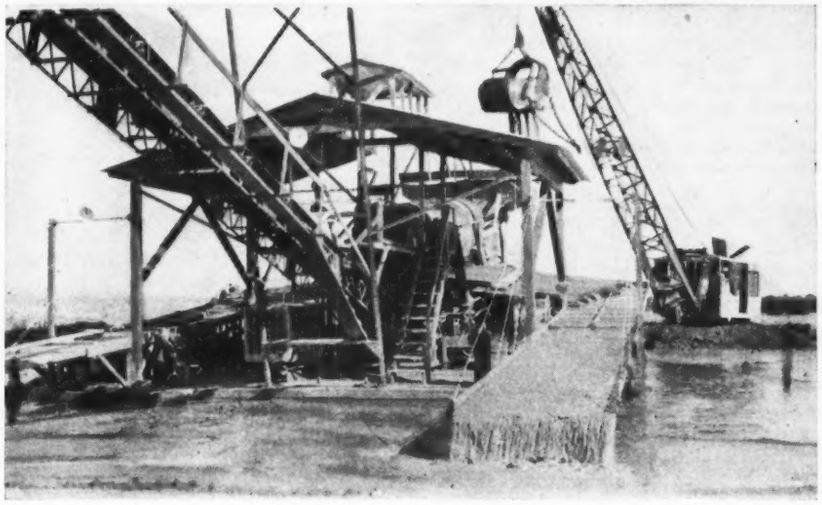
Power costs have been reduced mate-

rially by the use of diesel engines instead of the conventional gasoline units. One plant is driven electrically. All draglines working in the district are caterpillar-mounted. As to total operating time per day, the equipment in most cases is run 20 out of 24 hours. The plants are operated on a three-shift basis, with three men on each shift. During the day shift a mechanic and a roustabout are employed in addition to the regular crew. Large floodlights installed at suitable points on the washery provide adequate light for night operations. The necessary current is furnished by a small lighting plant on the upper deck of the hull. An accessory that insures continuous operations is a portable repair shop with a welding outfit. In the Lincoln district, these are mounted on a motor truck, and contain, besides the welding unit, a small drill press, a vise, and sundry cutting and riveting tools. Diesel-powered tractors equipped with a scraper blade are frequently used for removing soft and shallow overburden.

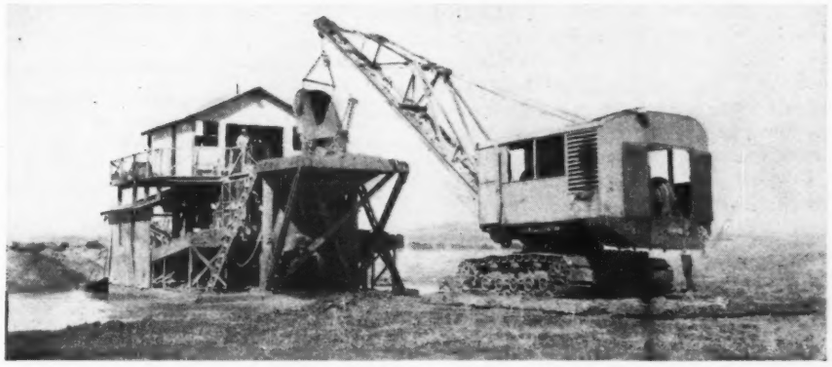
The newest plant to be placed in operation is that of E. M. Kaufield, of Oakland, Calif. The company is working one of two 160-acre tracts held under lease about 2 miles east of Lincoln. The property is known as the Fay placer. Overburden upon the bedrock ranges from 8 to 15 ft. in thickness and consists of gravel, sand, and topsoil. The topmost layer of overburden, 2 to 4 ft. thick, contains no values and is removed prior to the excavation of the gravel proper. Pay gravel averages 50c. in gold per yard.



AT THE FAY PLACER, near Lincoln, worked by E. M. Kaufield, of Oakland. Dragline and Page-type bucket are delivering 50c. gravel to the floating washing plant

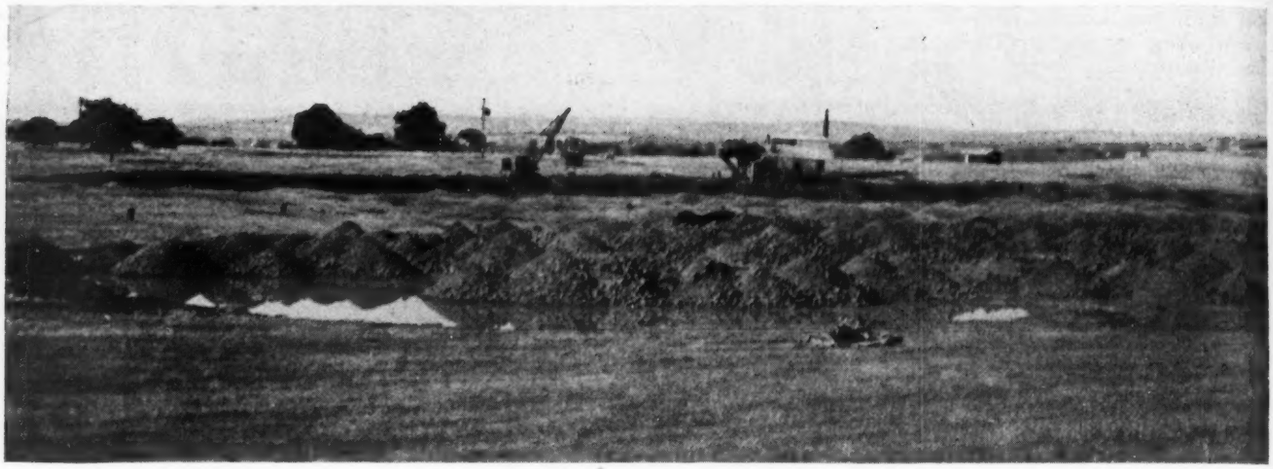


STACKER END of the washing plant at the Fay placer. All superstructures, including the gantry that supports the tailings stacker, are built of steel. The scow's hull is built of wood



THE VIRGINIA PLACER COMPANY is dredging here in the Mount Pleasant district, about 4½ miles from the Kaufield operation. The gravel is reported to run 75c. per cubic yard

DRAGLINE AND WASHING PLANT of Lincoln Gold Dredging Company, controlled by Oroville interests. Pay gravel contains about 24c. gold per cubic yard. The dragline truck rests upon sectionalized wooden mattins



ELECTRICALLY DRIVEN EQUIPMENT features the installation of the Oakwood Mining Company. The plant is practically the same in design and size as that of the Lincoln Gold Dredging Company. Worked-out area and tailings in foreground

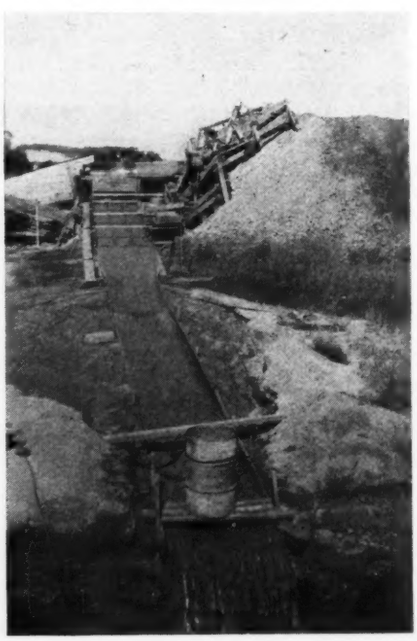
The bedrock is fairly even and consists of decomposed granite. About one foot of it is removed along with the gravel to recover possible crevices rich in gold. The gold is distributed evenly in the gravel, and the particles recovered in the sluices are fine and flaky.

Equipment used for excavating and washing the gravel consists of a diesel-powered Link-Belt dragline using a 60-ft. boom and a 1½-cu.yd. Page-type bucket, and a floating washing plant. Considerable study of the ground and gravel preceded the design and selection of these units. The hull of the washing plant is built of wood and measures 30 by 40 by 2 ft. All superstructures, including the gantry supporting the tailings stacker, are built of steel. Excavated gravel is dumped by the bucket upon a steel grizzly, spaced 8 in., covering the mouth of the 10x12-ft. steel hopper at the bow end of the hull. Grizzly undersize flows by gravity to the scrubber portion of the revolving screen, which is 28 ft. long over all, 4 ft. 6 in. in diameter, and chain-driven. The screen section is 16 ft. long. It is covered with semicircular steel plates containing ⅜-in. and ⅝-in. perforations. Spiral baffles are provided in the scrubber end of the revolving screen to effect a better disintegration of the gravel, which occasionally is packed with clay.

Screened material drops into a distributor at the bottom of the screen, whence it is fed to the gold tables on each side of the revolving screen. These are divided into six sluices, each 30 in. wide, fitted with Hungarian riffles and mercury traps at suitable points, which discharge into two tail sluices 62 ft. long and 30 in. wide. About 32 ft. of the total length of latter sluices is provided with riffles. Total sluicing area is about 750 sq.ft. Nearly all values are recovered within a sluice length of 4 ft. beyond the distributor. Tailings or screen oversize are disposed of by a 55-ft. stacker equipped with a 24-in. conveyor belt. Pumping equipment consists of a 6-in. Fairbanks-Morse centrifugal pump, and an 8-in. pump, also of Fairbanks-Morse make. Motive power for the revolving screen, stacker, pumps, and lighting plant is furnished by a 60-hp. Caterpillar diesel engine. The plant has a capacity of 300 cu.yd. per hour and is operated on a three-shift basis. A repair man and a roustabout are employed during the day shift in addition to the regular crew of three men on each shift.

In the Mount Pleasant district, about 4½ miles northwest of the Kaufield operation, is the plant of the Virginia Placer Company, controlled by Sherman Tharp and T. E. Robinson, of Oakland, Calif. The property comprises 160 acres of placer land, on which the company is now working a gravel channel 100 ft. wide, averaging 75c. per yard. Gravel overlying the bedrock is 15 ft. thick. This includes 2 ft. of barren topsoil, which is removed by the dragline, or, where ground conditions permit, by a diesel tractor equipped with a scraper blade. Usually two hours a day are devoted to this work. Though the bedrock generally consists of decomposed granite, false bedrock of red hardpan and clay and cemented gravel have been encountered frequently.

STATIONARY WASHING PLANT and tail sluice, belonging to C. N. Chittenden, of Lincoln, who is working a 20-acre tract. Excavation is done by a ¾-cu.yd. gasoline shovel



The digging element used here is a Model 700 P & H dragline, altered to meet the requirements of the bedrock and gravel. As will be noted in the accompanying cut, it is provided with a steel gantry to increase the service range of the 60-ft. boom. The 1½-cu.yd. Essco bucket is designed to dig through and break up hard gravel. In this operation the dragline is powered by a 120-hp. Waukesha engine, burning diesel oil, and its capacity is 200 cu.yd. per hour. The 100-ft. gravel channel is removed by excavating laterally across the face and then stepping back the dragline.

Capacity of the floating washing plant is 100 cu.yd. per hour. It is similar in design to that of the neighboring plant described previously. The wooden hull is 30 ft. wide, 40 ft. long, and 30 in. deep, and draws from 13 to 15 in. of water. All superstructures are of steel. The mouth of the steel hopper is covered with a steel grizzly, spaced 8 in., and the scrubber portion of the revolving screen is fitted with a series of spiral flights with lifters in between to disintegrate the gravel better and insure a steady flow of material to the screens. Over-all length of the revolving screen is 26 ft. The screen section is 16 ft. long, and is covered with sectional steel plates containing ⅝-in. holes. The gold table area on each side of the revolving screen is divided into six sluices, each 2 ft. wide and about 12 ft. long, equipped with Hungarian riffles

and mercury traps. These discharge into four riffled tailings sluices, running the entire length of the hull and emptying at the stern end of the hull. The stacker is 60 ft. long and employs a 24-in. conveyor belt. It is supported by a steel gantry and operated by hand winches in the pilot house.

Water for the revolving screen and other purposes is provided by a 8-in. Fairbanks-Morse centrifugal pump capable of delivering 1,500 g.p.m. at 40-lb. pressure. The auxiliary unit is a 6-in., 800-g.p.m. Fairbanks-Morse pump. The power equipment on the washing plant consists of two 40-hp. Caterpillar diesel engines, one of which drives the main water pump through a V-belt drive, and the other the revolving screen, stacker, auxiliary pump, and the lighting plant. The equipment is operated on the same basis as is the Kaufield plant, with the same number of men employed on each shift.

The property of the Lincoln Gold Dredging Company, controlled by E. M. Clark, H. F. England, P. W. Baker, and E. J. Hocking, all of Oroville, Calif., is 4 miles north of Lincoln, and comprises 240 acres of land. Of this only 75 acres is workable. The layer of gravel above bedrock is from 5 to 14 ft. thick, averaging 24c. per yard. Width of the pay channel is 500 ft. False bedrock consisting of lava ash is frequently cut at different points in the channel. The pay gravel and about 2 ft. of bedrock are removed by a P & H dragline equipped with a 60-ft. boom and a 1¼-cu.yd. automatic Page bucket. The dragline employs a caterpillar truck, which rests upon a sectionalized wooden matting when operating in soft or soggy ground.

The washing plant is built of wood and consists of a hull 26 ft. wide, 30 ft. long, and 3 ft. 4 in. deep; a hopper equipped with a steel grizzly having a 13-in. spacing; revolving screen 4 ft. in diameter and 25 ft. over-all length; gold tables on each side of the revolving screen divided into seven sluices, each 28 in. wide and about 10 ft. long; two tailings sluices 4 ft. wide and 45 ft. long; a 45-ft. stacker with a 24-in. conveyor belt; and a 7-in. Yuba centrifugal pump. Power is furnished by a 60-hp. Caterpillar diesel engine.

The table and tailings sluices contain Hungarian riffles, and about three flasks of mercury are used in the traps installed at suitable points in the gold-table area. Contrary to conventional practice, the scrubber part of the revolving screen is at the discharge end instead of at the hopper end of the trommel. The scrubber proper is fitted with spiral baffles and steel lifters, which throw the gravel back into the screen section, with the idea of keeping it longer there and thus effecting better disintegration. The holes of the 16-ft. screen section are ⅜ in. in diameter. Capacity of the washing plant is 100 cu.yd. per hour. The dragline and the washery are worked 18 out of 24 hours. The equipment of the neighboring Oakwood Mining Company is electric driven, and practically identical in design and size.

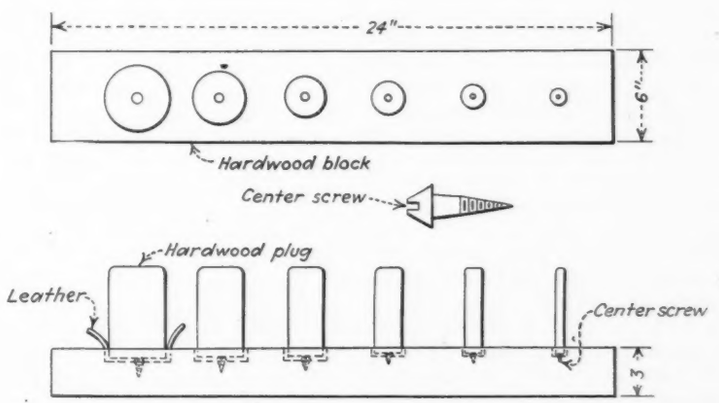
Of an entirely different nature is the operation of C. N. Chittenden, of Lincoln, who works twenty acres of gold-bearing gravel one mile west of the plant of the Oakwood company. Barren overburden 4 to 6 ft. thick and about 10 ft. of gravel, are removed separately by a ½-yd. Universal gasoline shovel, the pay gravel being trucked by 3-ton Ford trucks to a stationary washing plant, about 1,000 ft. from the pit. The gold content averages 45c. per yard. Each truck dumps its load into a wooden hopper installed at the top of an earth-filled ramp, from which the gravel is fed evenly to a combination scrubber and screen, 5 ft. in diameter and 16 ft. long, driven by a small gasoline engine. The screen section of the revolving trommel is but 6 ft. long and is covered with sectionalized steel plates containing ⅜-in. and ¼-in. perforations. Screen undersize, which constitutes from 60 to 70 per cent of the feed, flows to three riffled sluices each 2 ft. wide and 30 ft. long. Each sluice contains a mercury trap. Sluice tailings collected in a sump are elevated by a centrifugal sand pump and passed over a second set of riffled sluices before going to waste. Boulders and screen oversize go via an incline conveyor belt to a wooden loading bin, which is periodically emptied by one of the three trucks available at the property. A total of 300 cu.yd. of gravel is treated a day. The plant is operated on a two-shift basis, five men on each shift.

Forming Cup Leathers

REMOTE MINING CONCERNS frequently have urgent need of cup leathers for stoper drills, gasoline lamp, lantern, and stove pumps, tire pumps, and even the small sizes of piston water pumps which use cup leathers instead of a metal piston. Though the leathers are inexpensive, a complete variety of sizes will seldom be found in the mine stockroom. Having been confronted with this situation on various occasions, Evan W. Baker, master mechanic, Bunker Hill Arizona Mining Company, Sombrero Butte, Ariz., devised a simple and economical method of forming any desired size of cup leather.

Holes of the diameters of the cup leathers wanted were bored in a block of 3x6x24-in. hardwood. Plugs of the same material were then turned, as shown in the accompanying sketch. These plugs should be of a diameter equal to that of the hole, less twice the thickness of the leather used, plus $\frac{1}{32}$ in. For the leather cups of 1 in. diameter or more, leather of a thickness of ⅛ in. should be used. For the smaller cups $\frac{1}{16}$-in. leather is suitable. The sharp edges of both holes and plugs should be smoothed down with sandpaper, to prevent damage to the leather as it is forced in shape.

To make the leathers, the stock should be soaked in water for a few minutes.



A piece of ample size is then cut off, placed over the correct hole in the hardwood block, and the corresponding plug is then placed on the leather and driven in with a mallet. Projecting edges of the leather are then trimmed off with an old razor blade of the single-edge type. Within a few minutes the leather cup may be removed and used, but when time permits the cups should be allowed to dry in the block. They may then be removed and coated with neatsfoot oil.

A wood screw, with the head ground as shown in the sketch, is screwed into the center of each hole. This makes a center mark on each cup and facilitates the scribing and punching of the hole to accommodate the pump rod.

Total cost of $616.60 is obtained for 2,900 ft. of hole put down with earth augers of various types

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Pulling a sample. A 12-in. ship auger would take 6 in. of tailings approximately at one lift. The post-hole type worked better in sand than the other, but not so well in slimes

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Sampling Yellow Aster Tailings

Alfred B. Sabin

Mill Superintendent, Yellow Aster Mine
Randsburg, Calif.

HIGHER PRICES FOR GOLD have made many an old tailings pile look interesting. As one approaches Randsburg, in California, from Mojave, the tailings from the Yellow Aster milling operations stand up in conspicuous cliffs and dunes. Originally there must have been about 3,000,000 tons. Of this approximately 2,250,000 tons remains. The rest has been washed and blown away, mostly the latter, as any Randsburg housewife who has cleaned house after a windstorm will affirm.

The tailings lie roughly in three blocks—one on each side of a valley below the mill and another farther down on the valley's eastern side, but all are connected. Depths vary from an average of 16 ft. in the lower dump to 100 ft. in the one opposite the mill. The tailings were impounded, for the most part, by spreading launders built around the periphery where the sand was allowed to accumulate and the slime was settled in the ponds thus inclosed. For this reason, probably, one finds accumulations of sand in one place and slime in another.

When the tailings were taken over by the Anglo American Mining Corporation, Ltd., we had to know as accurately and quickly as was compatible with economy just what we had. A crew of four men was organized and the needed equipment worked out. Some of this is of novel design and should interest others having a similar problem.

Several types of augers were tried. Most successful were the 2-in. ship augers and the post-hole type consisting of two parallel curved blades 7 in. long, appropriately shaped and sharpened for digging at the points. The ship augers worked well in damp slime, the sample packing into the helical groove. A 12-in. auger would pull about 6 in. of hole at one lift. In slime the post-hole auger tended to pack at less than 6 in. of hole; but in sand which had a tendency to flow it worked better than the ship auger, because the core was supported on the sides. Each type was used where it worked best.

The extension shanks for the augers were made of ¾-in. pipe cut in 5-, 15-, and 20-ft. lengths, with a short nipple on the upper end, to which a "tee" handle was fitted with a quickly detachable device much like a pressure grease fitting. This was worth while in that it saved time, because every 6 in. or less the handle had to be removed, the pipe pulled, and the auger cleaned.

On the shallow holes a double stepladder was used as a scaffold for holding the upper end of the pipe while the auger was being cleaned. For the deeper holes, it became necessary to use a tripod with 20-ft. legs of 1½-in. pipe and a guide at the apex through which the longer pipe length could be thrust. Thus, it was possible to handle the pipe in 40-ft. sections, this saving much time on the deeper holes. Pipe and auger were raised by a double ¾-in. snatch block, as shown. The end of the rope was attached to the apex of the tripod, passed down to a snatch block at the bottom, up again to a snatch block at the apex, and down to the operator. The bottom block was equipped with a pipe hook. This was a piece of ½-in. flat iron about 6 in. long with a ring in the end attached to the block—the other end having a cross slot with parallel sides slightly wider than the pipe, so that when pulled by the block it gripped the pipe, but when the rope was slacked off it fell free again.

To prevent caving at the collar of the hole and to avoid losing the sample by spillage, a shallow 16x16-in. box with a hole in the bottom was placed on the spot where the hole was to be started. If the surface layer were sandy or likely to cave in, a short length of 2½-in. pipe with a sleeve on one end was put into the hole up to the sleeve. To assist in handling and holding the pipe when lowering, raising, connecting or disconnecting sections, a so-called dog was put on the box. This dog was simple and consisted of two "V"-shaped irons made of 2x¼-in. flat iron, the upper points of the "V's" being hinged at the corners of the box so that the two apexes lapped in the center above the hole. The points were truncated, so that when meeting they were slightly raised. A near half-circle was cut in each half, so that when the pipe was inserted the two ends gripped the pipe. Bumpers were placed under each "V" to prevent either dropping too far. By locating these bumpers just right, the friction on the pipe was not quite enough to hold the weight unless pressure of the foot was brought to bear. Thus the operator was able to drop the auger smoothly, easily, and without the aid of the block, except to hold the weight when passing a sleeve. When raising the auger the block and hook were pulled to the apex of the tripod, the pipe going through the guide. When the pull on the block was slackened, it fell of its own weight, disengaging the hook, which dropped down for another hitch. When the block was eased off, the weight of the pipe and auger was taken by the dog at the bottom.

The pipe was cut in exact 5-ft. lengths or multiples of five feet, so that in taking 5-ft. samples no tape was necessary. These samples were placed in canvas bags and taken to the laboratory, where they were put through an 8-mesh screen. Balls of slime had to be broken up by hand. A split was made to secure samples for assay, screen analysis, and composites for test work.

The holes were spaced at 200-ft. coordinates where surface conditions permitted. Irregular areas necessitated irregular and sometimes closer spacing. All assays were weighted with their proportional tonnages when arriving at the average value. In all, 97 holes were bored, with a total of nearly 2,900 ft., at a labor cost of 165 shifts, totaling $616.60. Sample sacks, equipment assays, and supervision were extra. The total time from start to completion was 45 days.

Essential Criteria In Examining Gold Quartz Mines

Geological Guides That May Serve as Danger Signals Against Mistakes

John Carter Anderson
Consulting Mining Engineer
Beverly Hills, Calif.

SEARCH FOR GOLD MINES has been intensified by the present high price of the metal. This is bringing about the critical re-examination of a great number of mines formerly producing, and, frequently, large and often unwarranted expenditures for their re-equipment and operation. One may hazard the guess that almost every gold mine that was once a producer has been or will be submitted as worthy of examination. In many such cases the first and sometimes the only criterion applied is "past production." In view of the situation, a re-examination of generally accepted beliefs as to the origin and mode of occurrence of gold-bearing quartz veins is timely, with emphasis on the danger signals to be looked for in examining them.

In considering the offering of such a former producer, one may be inclined to forget that there were capable miners and engineers in those days, with a wider experience in such mines. In 1930, by way of contrast, there were only 31 gold mines in the United States having a production in excess of $100,000 a year—too few in number to educate many engineers in the problems of gold mining.

Two reasons can be given as to why the old-timers quit: Either they did not find the gold, or they took it all. Unless it can be shown that the work was suspended because of then insuperable difficulties in metallurgy, or bona fide legal entanglements, now settled, or some other equally good reason, one should demand some explanation as to why that general conclusion does not apply. If the examination be undertaken, it should be conducted with great caution and with an eye open for those danger signals as to the approaching decease of the vein that the men who closed down the work were probably able to see and understand.

> The engineer must be on guard when reporting on properties that were once productive . . . In most cases the earlier operators quit because they could not find the metal or because it had all been taken out . . . A good reason for further consideration of such mines should be visible.

I have been called upon to examine many mines and prospects where the accident of erosion, or the work of man, has exhausted, or almost exhausted, all possibilities for further profitable production. From this experience certain fundamental facts are so conclusive that they furnish valuable criteria applicable to the examination of gold mines old and new.

The more valuable of these have come from my experience with those veins that have been mined by natural erosion and are not now worth mining by man. Too much emphasis cannot be laid on the value of the geologic data here to be found, because of the tendency of many geologists to ignore them, as not applicable to the study of productive mines. They open to our eyes certain transitions from commercial to uncommercial phases of ore deposition often indicated, but seldom fully exposed, or, if exposed, seldom recognized today in once productive mines. They may furnish, therefore, more valuable criteria to the examination of such mines than can be had from any other source.

As many of the observations on which this paper is based were made in the course of examinations where the verdict had to be: "of no value," or "without further possibilities," no names will be used to designate the examples given. They come from a wide territory from Mexico to Alaska, and are, it is believed, of general, not just local, application.

Regardless of the values shown by one sample or by many samples, if any of the danger signals here indicated appear, they should not be disregarded. Recognition of them should intensify the study of the deposit to determine to what extent values in sight may outweigh doubts as to continued extension in depth of such values. If handled as a salvage operation, with a sharp limit on expenditures for equipment and development, such values may denote the possibility of a small but profitable exploitation.

Limitations of space do not permit a wide discursion into the all-important subject of ore genesis. All that follows is based squarely on the belief that all primary ore deposits are directly due to processes of segregation within the body of a cooling magma, and the injection of

these segregated products into the overlying crust. The tendency to segregation and migration continues until the final cooling of the mass and its offshoots, and from this directly arise the gold-bearing quartz veins.

Many times have I viewed what I have been pleased to call "the birth of a quartz vein"—a vein exposed by erosion at the point where the quartz first fully segregated from its parent rock and thence went upward alone. That the veins so exposed are without further economic value does not detract from the value of the evidence they give on the question of ore deposition.

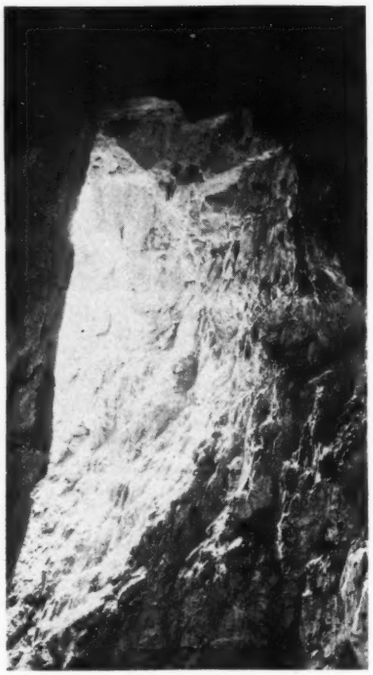
Complex conditions of temperature and pressure, of the composition of the magma, and the relative concentration of the several metals in the magmatic reservoir govern their segregation. But it is certain that in the cooling of the magma, quartz and the other components of ore deposits are still fluid at temperatures at which the rock minerals crystallize and so become segregated and concentrated therefrom.

If the crust was fractured, the fracture was filled by an inrush of the still fluid portion of the magma tapped by the fracture. The tendency to segregation continued therein until crystallization was complete. The more fluid the components, the farther they traveled from the mass, until a point was reached at which they departed once and for all from the rock with which they came. For they had now cooled to a temperature at which the rock minerals could no longer remain fluid. At this point we have the birth of a quartz vein.

Conversely, when that point is reached, either by natural erosion or in the course of mining, we might say we have seen the death of a quartz vein. For we have seen its bottom.

The bottom of a quartz vein may or may not be the bottom of economic possibilities, but it is the bottom of one phase, usually the most and often the only productive one. Hence its recognition, or the recognition of its near approach, is of utmost importance in the examination of a mine, old or new. The difficulty is that it is seldom recognized, as such, in the productive mine. As mining deepened, a change took place either in the grade or component minerals of the ore, which made further operation unprofitable. So mining stopped, without reaching an explanation of the reason for these changes. For such an explanation we must often look to those uncommercial deposits where erosion has exposed a similar or deeper phase.

Every quartz vein, I believe, will be found to have a direct connection with an igneous mass, to have come from it by processes of segregation, and to have drawn its mineral content therefrom by similar processes. The relative concentration of the several metals varies in each magmatic province and in different localities within that province. Each must be studied by itself to learn what metals predominated, but the same laws govern and may be applied with certainty. A persistent increase in the baser metals indicates an early decrease in gold. This may be gradual, or it may be abrupt. But it is positive. In some districts, however, a little galena in the ore is favorable to good gold values and to high values in the concentrates. The greater the fineness of the gold, the better chance for persistence in depth. A marked decrease in fineness indicates an approach to the bottom of the gold zone.



AN OLD STOPE in one of the gold-quartz mines of the California Mother Lode

Each district must be studied by itself to learn the relative concentration of the several metals and something of the vertical range within which these changes occur.

During the consolidation of a magma a continuous tendency exists toward the segregation of its components into acid and basic fractions, resulting, where there is a local relief of pressure, in the intrusion into the overlying crust of acid and basic dikes. The sequence of such offshoots is of great interest in the study of ore deposits. This can be developed at length at another time. Suffice it to say here, that in each magmatic province we find a series of such offshoots, some pre-mineral, some post-mineral, and one which is directly responsible for the introduction of the ore.

The first essential in the study of every mine is to determine which intrusive rock was the one responsible for the deposition of the ore. To do this the examining engineer must almost always carry his study farther afield than the particular mine he is examining. Only so can he see the series of events which in that district led up to the deposition of the ore. To be able to pass sound judgment he must carry his study far enough to be able (1) To know each rock in the area, and to be able to recognize it under all its varying phases of texture and alteration. (2) To know the relationship of each rock to the others. (3) To know the relationship of one or the other to the ore. This is the foundation of all geologic study of a mine.

These relationships are difficult to determine, and many mistakes result from a failure to recognize them correctly. Often, the igneous rock directly in contact with the ore and in apparent genetic relationship with it has no such relationship. It may appear to have it when, in fact, its contact was simply a point of weakness followed, in depth, by a later dike and by the solutions therefrom as a channel of circulation. Such later dike may not have been exposed by erosion or by mining and can only be inferred from the relationships seen here and in the surrounding area. Case No. 1, hereinafter, illustrates this point.

However, once the type of dike responsible for the deposition of the ore is determined for a district, its possible presence and the effect thereof must be considered in a study of every other deposit in this district.

Disregarding for the present the deeper contact phases of base-ore deposits which are found in association with igneous rocks, and concerning ourselves solely with the gold-bearing quartz veins, it appears, from my experience, that in each district the intrusive rock most directly responsible for the introduction of the ore is the most acid fraction coming from the invading magma. If the magma were a granite, the dike will be a rhyolite or aplite; if a diorite, a quartz diorite porphyry; if gabbro, a dacite or quartz dacite porphyry. But in each case its relationships to the magma and to the veins are the same.

Besides its presence in contact with or near a vein, which relationship, as has been said, may be structural only, not genetic, such a dike can often be recognized by the presence of finely disseminated pyrite as a primary mineral of the rock, not in seams only. The discovery of such a dike in a quartz vein gives both an explanation of its origin and sets up a danger signal of its approaching end. See Cases 1, 6, 7, and 8.

This danger signal should never be disregarded. Usually it will not be found in the productive horizons of the vein, as it did not reach as high into the crust as did the quartz that segregated from it. Hence, that such a connection exists has often been denied. The presence of one implies the presence of the other, though the quartz may have been destroyed by erosion.

A sufficiently wide study of a gold-producing area will nearly always disclose the presence of this type of dike, either in surface outcrop or in underground working. The relationships there seen will furnish a guide for the study of all other quartz veins of the district.

When development work has disclosed or does disclose such a dike, or one of the characteristic indicators of its near-by presence, great caution should be used in predicting any great further extension in depth of the ore deposit, despite the grade and width of the ore found in such work. If, at the same time, the bottom level shows a marked lowering in either grade or width, the discovery of such a dike is almost certainly a danger signal of pressing importance.

Pegmatitic Phase Transitional

Much has been written of the association in some districts of gold with pegmatites, but the nature and frequency of this association have not been as fully understood as they should be—probably because this pegmatitic phase is often so limited in extent as to pass unrecognized. Yet, in my experience, it is one of the most frequent and most positive signals of the impending death of a quartz vein.

Study of a great many outcrops in areas where erosion has largely destroyed the horizons in which the gold-bearing quartz veins were formed shows that at and near the top limit of the dike with which they were associated there was a tendency to the local segregation of its component minerals, the feldspar crystallizing separately, often in large pegmatitic crystals, the quartz as irregular quartz veinlets without continuity or persistence. Usually, the range of travel of the feldspar was small, as, once separated from the quartz, it quickly cooled to the temperature of crystallization. Often the gray or white feldspar is not recognized as such, being thought to be simply a different character of quartz. Thereafter the quartz continued upward alone, with its burden of metallic minerals. If the nature of the invaded rocks and the physical condition of the fracturing permitted, it very quickly assumed a definite course and formed a typical quartz vein.

That the quartz so formed may have been destroyed by erosion does not invalidate the evidence to be had from such outcrops. For too often we have proof from the placers below or from actual production from similar veins near by where erosion did not completely destroy the quartz veins, that such veins existed and were richly gold-bearing.

So, in the examination of any prospect or of a once productive mine, if a point is found where the quartz tends to break up into irregular stringers, in or near a dike, or to be associated with feldspar, it is a danger signal not to be disregarded. Do not predict any future for the vein unless or until it has been demonstrated that in that district, as sometimes happens, the values continue in depth as a contact deposit along the dike. For it is certain that the dike will be discovered at slightly greater depth, and that the quartz vein, as such, will soon die out. See Cases 2, 3, 4, 5, and 6.

That this change may take place without any change in the appearance of or abundance of the pyrite in the vein is notable. See Case No. 1. So, if in the examination of a former producing mine it is found that on the bottom level a sharp drop in gold value takes place without other change in the appearance of the quartz or its pyrite content, beware. It may be but a step farther until the feldspars appear, the quartz begins to feather out, and the dike is found, and below this point the quartz vein, as such, may not be expected to be found or to be profitable, if found.

Pyrite may persist through these changes and on down in the dike. Its presence in a dike as one of the primary minerals is the best proof that the mineralizing dike, to use a much misused but very descriptive term, has been determined for that district. But it will decrease in gold content and a point will be reached in the dike where it disappears. That is, when the deposit was formed, the pyrite did not form until the dike had cooled to a temperature at which it could crystallize, and so it occurs near the top in the fine-textured, quickly-cooled phase of the dike there found. Above this point pyrite continued to crystallize with the pegmatite and the quartz, but the gold seldom precipitated in quantity until a little higher, hence cooler, horizon was reached. See description of Cases 1, 6, 7, and 8.

All of these several stages can be seen in deeply eroded outcrops and can and must be anticipated in the deepening of a producing gold-bearing quartz mine.

When the Baser Minerals Increase

The baser minerals—silver, lead, zinc, and copper—crystallized at higher temperatures and greater depth in that descending order. All of them may be found in quartz veins and associated with gold. But in the typical gold-bearing quartz veins from which the bulk of our gold has come, an increase in them is a danger signal of the impending loss of the gold. See the comment on Case 8.

One must understand also that the phenomena of zoning due to drop in temperature may take place laterally as well as vertically, and in those cases where the dike is in contact with formations which, for either physical or chemical reasons, are permeable by mineral-bearing solutions, gold, quartz, pyrite, and the baser metals may be deposited as contact veins along one wall or both walls of the dike. So, a clean quartz vein may in depth give way to a contact vein which will carry commercial values to greater depth. But in most gold districts this is the exception rather than the rule, and, unless clearly proved in a district, it should be given little weight in estimating the possibilities for extension in depth of a quartz vein.

To illustrate these principles a brief description is given of some of the widely separated districts where a practical application of them may be seen.

Eight Significant Cases

Case No. 1—It was reported that the mine had produced $500,000; that 5,000 tons of ore averaging 1.0 oz. gold was in sight; that a parallel vein cut in the old workings averaged 0.25 oz. gold for a width of 18 ft.; and that a large tonnage could be developed on these and other parallel veins by driving a deeper tunnel.

The veins occur in fissures in a coarse-textured siliceous diorite porphyry and on its contacts with andesite. The main vein was opened by a series of tunnels, of which only the two lower are now open. Quartz was more abundant in the upper levels and is said to have paid $500 to the ton. The ratio of quartz to crushed wall rock in the vein decreased with depth, as did the values.

Where first cut in a branch of the lowest tunnel, the vein is 2 ft. wide and assays 0.95 oz. gold. There is a 4-in. streak of quartz on the footwall, which carries all the values, the remainder of the vein being crushed wall rock. In the face of a 20-ft. drift the vein is 4 ft. wide between good walls, but it shows almost no quartz and assays only a trace in gold. The vein was cut 150 ft. farther in, by a second crosscut from the tunnel. Here it is 3 ft. wide, of crushed wall rock without quartz, and assays a trace in gold.

Several hundred feet more of drifting and crosscutting on this level failed to find ore, though there was always at least one strong wall to follow. A winze was sunk 50 ft. and a short drift driven from the bottom between strong walls. This work disclosed a thin wedge of a more acid felsitic porphyry, full of disseminated pyrite, intruded between the diorite porphyry and the andesite, and having the same rake as the oreshoots in the upper levels. To it is frozen a narrow streak of quartz from which a few sacks of good ore had been sorted. This quartz is free from the andesite on its other wall.

Because of the occurrence of the veins in and on the contacts of the diorite porphyry throughout the district, it has been thought that there was a genetic relationship between the diorite porphyry and the veins. But certainly,

from the relationships seen in this winze, it was the intrusion of this later dike along the contacts of the diorite porphyry, not the intrusion of that rock, which was responsible for the introduction of the ore. The drop in values in the vein as the quartz decreased in amount and lost definite form signaled the approach to a dike of this type. The finding of the dike proves the correctness of the signal. No one should hope that any amount of deeper work would again open oreshoots such as were mined above the dike. This mine can be considered only as a salvage operation, looking to the extraction of the few thousand tons of ore remaining in the old workings as cheaply as possible without further expenditures for development.

As this mine lies in a district which has had several producing mines with records up to $8,000,000 in early days, the lessons here learned have a wider application than to the particular mine alone. On a statement of past production and a demonstrable showing that ore of at present commercial value was left in the bottom of the old workings, some of these mines may appear inviting for re-examination and reopening. However, in the light of the genetic conditions found in the case cited, the danger signals there established should be most diligently looked for before expenditures are recommended on such properties. It is of interest to note also that on one such mine, having had a production of more than $2,000,000 to a depth of 500 ft., of ore averaging $50 or more, and with $12 ore left in the bottom, several thousand feet of tunnel and drift have since been driven on the 1,000 ft. level unsuccessfully. It is the belief of a capable engineer that they failed to find ore because of a miscalculation as to dip, and that a little more work will find it. But no such work should be done before a careful study is made to see if these danger signals are present. It may well be that a later dike, of the type discovered in the winze just described, has been cut in the lower tunnel without recognition of its relationship to the quartz vein above; in which case the quartz vein may not be expected on this level, and any further development or exploration should be confined to a cautious deepening of the old workings above.

The Ore Gone

Case No. 2—From several flat-lying lenses of quartz in metamorphic shale 100,000 tons of ore averaging 0.5 oz. gold was mined. Wide faces of quartz showed in the bottom of old workings. Could the mine again be made a producer?

It was found that the old-timers had mined all the ore; that the values, but not the iron, left the quartz a few feet before it actually bottomed; that the quartz decreased from widths of 10 ft. or more to irregular stringers mixed with pegmatitic feldspar crystals within 25 ft. below the old stopes; that both quartz and feldspar died out within 25 ft. more in the top of an aplite sill, which quickly increased in size and lost all trace of mineralization.

Unless a lens of quartz as yet unmined by man or by erosion could be found, there were no further possibilities in the property, and the danger signals to be looked for in further development were definitely established. Continued study of the area showed that in every case where a quartz outcrop had not been mined the danger signals of impending death were also present, making any attempt at development inadvisable.

An Aplite Dike

Case No. 3—In the hills above a district notable for its dry placers a narrow quartz vein, opened by several tunnels, had yielded $30,000 in gold. Starting at the foot of the hill the vein can be traced over the hill, down the other side, and up and over the second hill. The production came from the upper tunnels in the first hill. A little quartz was found, but none stoped in the lower tunnel. A winze sunk at the best point showed 26 in. of iron-stained quartz at 3 ft. down, assaying 0.62 oz. gold; 20 in. at 13 ft. down, assaying 0.26 oz. gold; and 6 in. of crumbly white feldspar at 20 ft. down, assaying 0.26 oz. gold.

Ore was stoped to surface near the top of the hill. Near the bottom on the opposite side a shaft was sunk more than 100 ft. on the vein. A short drift on the 40-ft. level shows 16 in. of iron-stained quartz assaying 0.24 oz. gold. A short drift from the bottom of the shaft shows a mixture of quartz and white feldspar assaying from 0.04 to 0.12 oz. gold. Passing over the next ridge, a short tunnel shows 15 in. of good-looking quartz assaying 0.58 oz. gold. Several hundred feet of tunnel and drift, about 100 ft. deeper, found the bottom of the quartz and of the values, sampling from a trace to 0.06 oz. gold. Despite past production and some good assays, there is nothing to hope for in this instance from further development.

Open cuts farther down hill along the strike of the vein show the presence of an aplite dike, of the type which elsewhere in the district carries low values in gold. It is possible thus to again establish the relationships between the dike, the feldspar, the quartz veins, and the gold.

Case No. 4—A Mexican prospector reported the discovery of a gold vein and showed samples of quartz assaying 6.25 oz. gold. His story seemed worthy of belief, and a difficult trip was made to visit his find. Two miles before we reached the spot danger signals began to show up, and I said: "I fear it will have no extension in depth." It was an area of highly metamorphosed sediments cut by a series of granite porphyry dikes, and one outcrop after another of these dikes showed a transition to almost clean white feldspar.

When his find was reached it proved to be a residual fragment of quartz, a few feet in greatest dimension, pocketed in white feldspar which itself is pocketed in a granite porphyry dike. It is not and never will be a producing mine. But that rich gold veins had once existed in the area is proved by the presence of exceedingly rich dry placers in the wash below.

Case No. 5—The ancient gravel channels of California, as that of the Tertiary Yuba River, on which are the great hydraulic placer mines of Iowa Hill, Gold Run, and You Bet, are notable for the enormous amount of quartz in the gravel, and the absence of any comparable quartz mines today in the area they drained. An explanation of the source of this quartz may be had from the following.

Pocket hunters had followed tiny stringers of quartz in a wide buff-colored acid dike. None of these persist more than a few feet in any direction. Some had yielded a few hundred dollars in pocket gold. At the top of a 50-ft. raise to surface, streaks of pegmatitic feldspar are found in the dike. On the top of the ridge 100 ft. higher is a strong quartz vein 15 ft. wide, well mineralized with pyrite. Seen elsewhere, this vein would look very attractive for development. Here it is apparent that it would bottom in the dike in a very few feet.

The dike can be followed for more than a mile, crossing the ancient gravel channel. Here and there, on a high point, is quartz to prove it the bottom of one of the mighty veins from which the old channel got its quartz and its gold. Granted it is not a mine, nor ever will be, but a study of the relationships it exposes between dike and feldspar and quartz gives more light on the source of the gold in the old placers than any producing mine in California reveals. If the genetic ralationships and danger signals it illustrates, as do the preceding cases, be heeded, many an expensive failure in development of a new mine or reopening of an old producer will be avoided.

A Salvage Job

Case No. 6—The reports submitted described a series of parallel quartz veins of great size and good gold values, on one of which careful sampling by a reputable engineer showed, in a tunnel, an oreshoot 265 ft. long, 14½ ft. wide, averaging 0.47 oz. gold. My examination checked the assay map, but also proved why the man for whom it was made had surrendered his option, leaving the ore unmined. It did not go down,

and there was too little ore above the tunnel level to justify the contract price.

A series of open cuts proved the continuation of the vein for an additional 450 ft., with a drop of 85 ft. below the tunnel level. They show the quartz to be 14 ft. to 20 ft. wide, and identical in appearance and in the amount and appearance of its pyrite content. But in a drop of 25 ft. below the tunnel the value decreased to 0.06 oz. gold, then to 0.02 oz. and 0.01 oz. gold.

After wider study of the area had determined the type of the mineral-bearing dike, in this case a quartz-albite diorite, and its relationship to the quartz veins, trenching disclosed it in contact with the barren part of this vein. The study of these other outcrops fully established the relationship between this type of dike and the veins. The dikes graded upward into almost pure gray feldspar, described as quartz in previous reports. This in turn gave way, upward, to white quartz, remnants of which could be found capping each little ridge. One such showed the outcrop of an apparent oreshoot 200 ft. long, giving surface samples assaying 0.5 oz. to 0.6 oz. gold. An open cut showed this value to drop to 0.02 oz. gold in a depth of 10 ft. With a further drop of 15 to 20 ft. at either end of the outcrop, the quartz itself dies out in a wide body of feldspar, which at greater depth passes into a quartz-albite diorite dike.

One outcrop, at the base of a vertical cliff, shows a beautiful quartz vein 20 ft. wide to feather out and disappear in the short vertical range of 20 ft. A tunnel in the heavily pyritized dike immediately below the bottom of the quartz showed the dike itself to assay 0.06 oz. gold. Similar values were found in other similar dike outcrops.

Seen by itself alone, the orebody in the tunnel looks attractive, but after seeing the transition from good quartz to barren quartz, and from barren quartz to feldspar and dike so positively proved in the other outcrops on the property, and finding the dike in contact with the barren quartz of the tunnel vein, the inevitable conclusion was that there is no ground for hope that deeper development will be a success. If considered as a salvage job only, without further expenditure for development, there exists 13,000 tons of ore developed above the tunnel level, with a small additional tonnage possible for 10 to 25 ft. below, that might pay to mine. Any larger program would fail.

In Grass Valley

Case No. 7—This comes from that most interesting of all gold districts in western America—Grass Valley. Here ore is being mined from depths of 9,000 ft. on the dip of the veins in the Empire Star and from lesser depths in several other mines. In the early days, here and in Nevada City adjoining, many mines were productive to moderate depths. Each is now submitted as having the same expectancy of extension in depth as there was in the case of the Empire and North Star.

Yet one of these mines shows a danger signal for which it would be well to look in any other being examined. It had been mined to a depth of 300 ft., with a good production. In an attempt to reopen it a new shaft was sunk 400 ft., the vein crosscut on that level, and drifts driven both ways without finding any ore. But the work disclosed an acid felsite dike full of pyrite, above which was ore. Here was the beginning and the end of the gold-bearing quartz vein.

One should expect to find the same condition in the other veins of the district at some depth. When discovered in the course of an examination or in mining, the presence of such a dike will be a danger signal as to the early end of the quartz vein.

LOADING ORE into a rocker-dump car at an underground chute in a gold-quartz mine on the Mother Lode

Case No. 8—This is in a placer district many miles in extent, where a number of valuable pockets have been found in quartz stringers, but as yet no profitable mines. It is of extreme interest because of the completeness of the demonstration that is afforded in many widely separated mines.

The basal magma of the region was unusually basic, a gabbro, the most acid dikes related to it being dacite porphyry. Several of these are known, and the placers were noticeably richer immediately below them. Where these dikes are wide, up to several hundred feet, the rock is a coarse "birdseye porphyry," without any mineralization. As they narrowed, in lateral as well as vertical progression, the texture became much finer, until no feldspar crystals can be seen and the rock can be recognized only by its resemblance to the gray felsitic groundmass of the coarse porphyry. With this change in texture pyrite becomes abundant. Near the top of the dike, quartz appears, first as erratic veinlets, then as small quartz veins, pinching out in the dike downward, increasing in width and continuity upward. In some outcrops no sign of the dike is seen, but large gray feldspars signal its near-by presence. Gold values may be very good in the small quartz veins, assays up to 4.16 oz. gold being had, and pockets of gold yielding up to $3,200 being reported from some of them. But in each case, in the space of a very few feet, values drop to almost nothing, and it is evident that no further extension in depth is to be hoped for. In each case the danger signals were everywhere present but unrecognized, and at several mines considerable money had been wasted in unsuccessful development.

Yield From "Lost" Vein

On one such, it was reported that a 14-ft. vein exposed in an open cut 20 ft. high assayed $21, but that the vein was "lost" and had not been cut by a long tunnel. On examination it proved to be a dacite porphyry dike, full of pyrite, with quartz stringers in the body of the dike that pinch from 2 ft. to nothing in the face of the cut. A sample of the quartz stringers assayed 0.2 oz. gold, though it may well be that higher assays could have been found at some place along the outcrop.

A crosscut tunnel, branching as it went in, cut the dike true to form in two places about 40 ft. below this open cut. Both crosscuts found the dike, well pyritized and assaying no gold and an ounce of silver, but no quartz vein. Not because it had been "lost" through faulting or misdirection of the work, but because the quartz vein bottomed between the two workings. No possibility exists of further work finding the vein here again in depth. At but little greater depth all trace of mineralization in the dike would disappear, and we would have the typical barren "birdseye porphyry" of the region.

The same conditions are found at many other mines in the district, and in every sample brought in, or taken in the course of this study, the presence of the dacite porphyry could be detected with the quartz. Here we have a district where the accident of erosion has mined the gold-bearing quartz veins, leaving nothing but the placers for man to exploit.

Until the origin of an ore deposit is understood, no sound judgment can be passed as to its possibilities for continuance.

Advance of

Improved Physical and

Where the service is extremely severe—underground and on the surface—where shock, vibration, abrasion, corrosion, and high temperatures mete out their punishment, where breakdowns are costly, where demands for safety are exacting, the engineer frequently turns to the high-quality steels for the successful solution of his problems

B. H. Strom

Metallurgist, Technical Service Department, Fisher Scientific Company, Pittsburgh, Pa.

TAPPING ALLOY STEEL. The electric furnace provides the high temperature and the careful operating control so essential in the production of high-quality steel

THE TERM ALLOY STEEL is one that is not easy to define. In the following it is meant to include steels containing one or more elements, outside of carbon, added to impart specific physical or chemical properties. Roughly, the alloying elements fall into two classes: those which dissolve in the iron, and the carbide-forming elements. Some metals may belong to both categories. The function of these elements may be to form compounds or solid solutions with the iron or the carbon; to change the critical cooling rate and thus affect the hardening properties; or to decrease grain size. Among the metals most commonly employed for alloying purposes are nickel, chromium, manganese (in excess of 1 per cent), molybdenum, tungsten, vanadium, copper, and silicon (above 0.5 per cent).

Production of the various alloy steels involves more careful metallurgical procedure than that of the plain carbon steels, for which the low cost of tonnage production is the most important factor. Intensive research has been required, not only to improve methods of production but to serve the consumers and to develop specific steels for specific purposes. The demand may be for greater tensile strength, increased hardness, resistance to wear and abrasion; for certain electric and magnetic properties; for stability at high temperatures or resistance to chemical attack. Whatever the case may be, steels now available possess qualities not anticipated a few years ago, and the field is yet far from fully explored.

Among the oldest alloy steels are the high-manganese steels, frequently called the Hadfield steels, after the inventor, whose brilliant research over fifty years ago resulted in an alloy steel with truly remarkable physical properties, one which was destined to become widely used in the mining field. This steel, which contains 10 to 14 per cent manganese and 1 to 1.4 per cent carbon, is very brittle in as-cast state, but the brittleness may be overcome by careful heat-treatment, soaking for several hours at about 1,850 deg. F., to dissolve the original carbide, followed by quenching in water to prevent carbide precipitation, thus retaining the austenitic condition. Great toughness, a tensile strength which may run as high as 125,000 lb. per square inch, an elongation of 45 per cent, and a hardness of 185 to 200 Brinell are thus obtained. However, this steel has a remarkable ability to work-harden; upon impact it will rapidly attain a surface hardness as high as 550 Brinell, with a ductile core. This surface hardness is maintained continuously during wear, giving the steel the wear- and shock-resisting properties for which it has become so well known.

At present the consumption of manganese steel in the United States totals around 100,000 tons annually. The uses, which are far too many to enumerate here, include crusher parts, mill and chute liners, rolls, gears and pinions, chains, shafts, elevator and dredge buckets, dipper teeth, conveyors, sprockets, sheaves and pulleys, and track crossings and switches. An interesting application where the service is extremely severe is in apron feeders for

the Alloy Steels

Chemical Properties Responsible for Extensive Use in Mining Field

ore crushers. Units have been built up to 8.5 ft. wide, with an hourly capacity of almost 1,000 tons, which stand up excellently and require very little maintenance.

A recent development is the addition of 3 to 5 per cent nickel to the standard Hadfield composition, generally with some decrease in the carbon content. This alloy may be used at moderately elevated temperatures, whereas ordinary manganese steel cannot be employed above 650 deg. F. without becoming brittle upon cooling. Welding of ordinary manganese steel has offered great difficulties for the same reason. With a welding rod of unalloyed steel the weld does not possess the strength of the metal itself, and a manganese steel rod cannot be recommended without proper heat-treatment of the welded part, a condition frequently impossible to fulfill. Welding with a rod of the new alloy, however, is a comparatively easy operation, producing a weld with physical properties equal to those of the main casting, and the weld does not become brittle upon cooling, as the nickel prevents precipitation of the carbides. The most important use of the new alloy is for building up worn parts, of carbon steel as well as of manganese steel. Excellent wearing properties are claimed for the parts built up in this manner.

Another modification of the standard Hadfield composition which is giving good results in the mining industry is one containing about 1 per cent chromium. This addition greatly increases the life of parts subject to abrasive wear under conditions which do not fully develop the surface hardness produced by work-hardening when the standard composition is used.

A steel with 1.5 per cent manganese and of comparatively high carbon content has been found to give good service where a material somewhat harder than ordinary carbon steel is required. It is easy to weld and machine, and is used for gears and pinions, tumblers and rollers, and mixing blades.

Use of nickel in alloy steel dates back over a hundred years; at present about 35 per cent of the world's nickel production is consumed for this purpose. The low alloy steels contain up to 5 per cent nickel, generally from 1.5 to 3.5 per cent, and usually 0.2 to 0.5 per cent carbon. High alloy steels may run as high as 35 per cent. The important function of nickel is to impart strength with slight, if any, decrease in ductility. It tends to reduce the grain size and produces a very tough steel with high compressive strength which does not crack easily. Nickel steel has much higher fatigue resistance than carbon steel, and the hardness is also greater, although not sufficient seriously to impair the machining qualities. In low-carbon steels nickel reduces aging embrittlement and grain growth in recrystallization. Appreciable benefits are obtained from additions around 2 per cent, and the improvement progresses up to about 5 per cent. Relative freedom from blowholes and good running properties make this steel a good material for castings. The high alloy nickel steels also possess important corrosion-resistant properties.

Combinations of nickel and chromium, frequently in ratio of 2 or 2.5 to 1, are also common in low alloy steels, for instance 3.5 per cent nickel and 1.5 per cent chromium, or 1.5 nickel and 0.6 chromium. Molybdenum is also frequently used with either one or both of these metals to improve the physical properties.

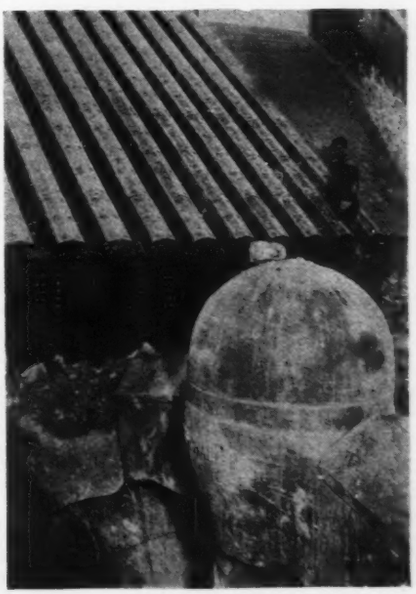
Rock drills which are subject to severe shocks and stresses in service are now largely constructed from alloy steels, such as a 3.5 per cent nickel steel, carburized and hardened. One manufacturer reports the use of steel with 3 to 5 per cent nickel in four-fifths of the parts, by weight; another uses 3.5 per cent nickel steel for 90 per cent of the parts. In addition to the superior performance resulting from improved physical properties, these steels also offer a high degree of uniformity in commercial production under ordinary conditions of operation. For severe service requiring unusual shock resistance, a case-hardened steel with 5 per cent nickel and 0.5 per cent chromium has been found highly satisfactory. Good results are also obtained with a steel containing 3 per cent nickel and 1.5 per cent chromium for valves. These compositions are only indicative of the trend and do not cover the numerous alloy steels used in this service.

Various nickel steels are also used in power shovels, conveyors, and loading equipment. A 2 per cent nickel steel of medium carbon content is used for crusher and power-shovel frames and for gears not subject to severe abrasion. For hardened gears and abrasion-resistant castings such as conveyor chain links, small crusher jaws, and dipper teeth, a steel with 1.3 per nickel and 0.75 to 0.9 per cent chromium may be used; and nickel-vanadium steels (1.5 Ni and 0.15-0.25 V) are used for highly stressed gears of shovels in very difficult and hard service. In cases of extreme abrasion, a nickel-chromium-molybdenum steel may be resorted to, of the following typical composition: nickel, 3 to 3.5 per cent; chromium, 1 to 1.25; molybdenum, 0.3 to 0.4; and carbon, 0.4 to 0.5 per cent. Crusher shafts of forged low-carbon steel with 3 to 3.5 per cent nickel and 1.5 per cent chromium have served for years under the most severe conditions without failure.

The question of reducing the weight of moving parts is one of great importance, affecting the construction of mine cars and locomotives, and hoisting equipment. Although the initial cost of high-strength steels may be high, the final analysis may frequently favor the use of the more expensive alloys instead of plain carbon steel and cast iron. Greater ease of installation, saving in power and lubricants, reduced maintenance, less loss of time from shutdowns, and increased safety may be sufficient to justify the higher capital expenditure.

Standardized designs for mine cages made from nickel and nickel-chromium steels have been developed in France and Belgium. Considerable savings in weight and in increased pay loads may be of value in deep shaft hoisting.

ONLY THE MOST RUGGED will suffice. Wearing caps of manganese steel are used at the feed end of this mammoth ore crusher

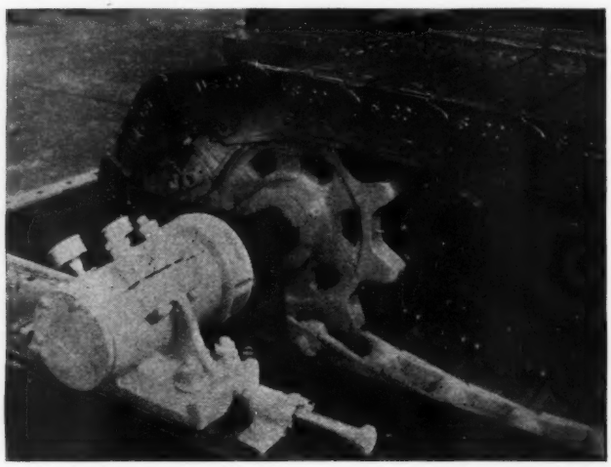


According to a statement by L. Lahoussay, in a report to the Central Committee on French Coal, the weight saved in a double-deck mine cage holding four cars, made from a steel with 2.6 per cent nickel, 0.6 to 0.8 chromium, and 0.35 per cent carbon was 31.5 per cent. For a four-deck cage holding two cars a saving in weight of 37.7 per cent was attained with an alloy of the same composition. In this case the economy realized by the reduction in weight of the hoisting rope required for a 3,000-ft. shaft would be sufficient to pay for the extra cost of the cage. It would also permit greater hoisting capacity, or hoisting from a greater depth without changing the motor. In a new installation the reduction in the size of the rope would also result in smaller dimensions of sheaves, drum, hoist motor, and headframe.

Industrial locomotives, particularly in mines and smelters, must be powerful and able to handle heavy loads. They are frequently subject to severe abuse and are expected to perform over long periods without breakdowns. Broken axles are common occurrences in such service, but the use of nickel steel, sometimes with chromium or molybdenum, or both, is an effective remedy for this difficulty. In a large Canadian nickel mine all storage-battery locomotives are equipped with 3.5 per cent nickel steel throughout for gears and axles. Many French mines specify forgings of 2 per cent nickel-steel for mine-car axles. In car couplings and hooks for cables in inclined shafts, the use of these steels will reduce breakage and materially increase safety. Recently all-metal hopper cars have been put into service, with cast nickel steel for truck sideframes, truck bolsters, and other cast members subject to stresses from heavy loads with variable and shifting centers of gravity.

Track crossings and switches are subject to especially heavy wear, from rolling and sliding wheels, as well as heavy impact and shock. Hadfield steel is used extensively for this service. However, a steel with 2.8 per cent nickel, 0.8 chromium, and 0.5 per cent carbon has also been found to stand up well. In France a steel with 2.8 per cent nickel, 0.3 to 0.5 carbon, 0.6 to 0.9 manganese, and 0.80 to 1.5 per cent chromium is used in this service. For very inaccessible track work the following composition has been used in Europe: nickel, 4.1 per cent; chromium, 0.65; molybdenum, 0.9; and carbon, 0.26 per cent.

Where mining operations are carried out in inaccessible regions, such as in Alaska, northern Canada, South America, and similar remote places, the cost of transporting equipment, frequently by airplane, makes the question of weight one of paramount importance. In such cases the strength-to-weight ratio of alloy steels may offer a practical solution. Remoteness from centers



PAN FEEDER, of manganese steel, for conveying coarse ore to crusher. Units of this type, made for hourly capacities up to about 1,000 tons, have been subjected to the most severe operating conditions for over four years, without breakdown

BATTERY LOCOMOTIVES in Joplin zinc mine. Worms, armature shafts, and transmission shafts are of 3.5 per cent nickel steel. Where the weight of moving parts is to be reduced, this alloy plays an important part

A BIG MOUTHFUL. Fifty tons of nickel steel was used in the construction of this 800-hp. electric shovel, equipped with 18-cu.yd. dipper. Universal axles cast from nickel-vanadium steel supply one of the features

DIPPER TEETH of chromium-vanadium steel, for service involving severe shock and abrasion. In addition to impact loads, they are also subject to a series of sudden bending loads. Molybdenum steel likewise is useful for this purpose

of civilization where spare parts may be obtained, and the difficulty of making large repairs at the property, furnish an added incentive to use the strongest equipment available. The best example to illustrate this is the construction of the two dredges for Bulolo Gold. These weighed 1,200 tons apiece and were made with some of the hull and superstructure parts of mild nickel steel. Additional equipment brought the total tonnage up to 4,000 tons, all of which was taken from the coast to the mine by airplanes. All shafting subject to heavy stress was made from 3.5 per cent nickel steel forgings, the largest handled being a 6,900-lb. tumbler shaft. Main drive gears and friction wheels, winch gears and upper tumbler body, were of nickel-chromium steel (2.5 to 3.0 Ni, 0.25 to 0.35 Cr, 0.65 to 0.75 Mn, 0.35 to 0.45 C). Low nickel-chromium steel castings (0.5 to 0.75 Ni, 0.25 to 0.35 Cr; 0.35 to 0.45 C) were used for rollers, screen tread rings, and spud kick castings.

Chromium is most frequently used in combination with other alloying metals, as in the many instances cited in the foregoing. The extensive use of nickel-chromium steels, with frequent additions of molybdenum or vanadium, has narrowed the field for the straight chromium steels. Castings with 1 to 3 per cent chromium are tough and give excellent service in rock crushers and in dredge and dipper teeth. Chromium imparts good deep-hardening properties, thus simplifying heat-treatment and insuring uniform properties throughout heavy sections and in castings with greatly varying dimensions. Grinding balls forged from a steel containing 1.2 to 1.5 per cent chromium and about 1 per cent carbon may be heat-treated to 600 Brinell, and give several times the life of ordinary plain carbon steel balls. In amounts from 4 to 6 per cent, with or without molybdenum or tungsten, chromium imparts moderate resistance to oxidation, up to about 1,100 deg. F., particularly with a high silicon content. If titanium is present a somewhat higher temperature may be allowed. Excellent strength and general corrosion resistance up to 1,100 deg. F. is also obtained with a steel containing 1.5 per cent chromium and 0.2 per cent vanadium. A steel with 1.5 per cent nickel, 0.75 chromium, and 0.3 per cent carbon was found to give good service in screw conveyors up to about 1,000 deg. F.

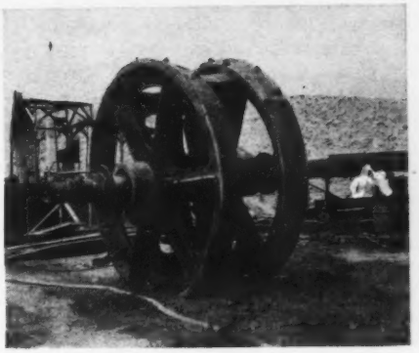
Chromium is the alloying element which when present in sufficiently high percentages imparts almost complete resistance to oxidation and sulphidization. This action is evidently caused by a thin, invisible, highly stable oxide film which offers complete protection from further attack; such protection is therefore contingent upon the presence of oxygen. The straight chromium steels used for resistance to corrosion and oxidation at high temperatures are divided into several distinct groups, with 4 to 6, 12 to 15, 15 to 18, 18 to 23, and 23 to 30 per cent chromium. While the major alloying element in all of these is chromium, and they are usually spoken of as straight chromium steels, they are, as a matter of fact, frequently modified by addition of relatively small percentages of molybdenum, tungsten, titanium, and silicon. For moderate temperatures, say up to 1,400 deg. F., a content of 15 per cent is required for good protection, but the higher temperatures, up to 1,800 deg. F., call for 25 to 30 per cent. At first the heat-resistant alloys contained only nickel and chromium, about 80 per cent nickel and 20 chromium, but it was soon discovered that iron could be used as a substitute for part of the nickel in certain applications. However, some nickel is often used to promote chemical stability and to convert the ferritic alloy into the austenitic state, thereby adding strength and toughness.

When corrosive conditions permit, the austenitic nickel-chromium alloys should be used, as they have the best mechanical properties at elevated temperatures; such alloys have given good service in hoppers and bins for hot calcine. The alloys containing 25 to 30 per cent chromium and 12 to 15 nickel, and 35 per cent nickel and 15 to 20 per cent chromium, show remarkable resistance to oxidation and corrosion, retaining appreciable strength up to about 2,000 deg. F.

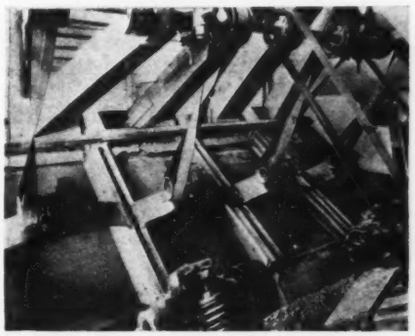
Where attack from sulphur occurs, the low carbon straight chromium alloys are used, with 25 to 30 per cent chromium for the highest temperatures, up to about 1,800 deg. F. Sometimes up to 3 per cent nickel is added to this composition to give better physical properties. This does not seriously impair its resistance to gases containing sulphur. If abrasion is present, such as in moving parts for mechanical roasting furnaces, a carbon content of 0.75 per cent imparts excellent wearing properties. Such parts have given a life of five years where plain cast iron wears out in three to twelve months. Other applications include heat recuperators, which have stood up one year at 1,800 deg. F.; structural parts for Cottrell treaters, feed pipes to smelting furnaces, air ports, valves, ventilating fans, and structural parts of flues.

Steels with 4 to 30 per cent chromium are used in piping, valves, and pumps for handling corrosive mine waters. Tanks, pumps, and pipe lines for corrosive reagents in flotation plants as well as pumps, valves, and fittings in electrolytic plants are sometimes made from austenitic steels with 18 to 25 per cent chromium and 7 to 12 per cent nickel, or low carbon, 18 per cent chromium steel. These materials, in the form of wire and nails, have also been used in the construction of wood-stave pipe and flumes for corrosive water. A 12 to 17 per cent chromium steel has been found superior to plain carbon steel for trommel screens and shaker plates in collieries and ore-dressing plants.

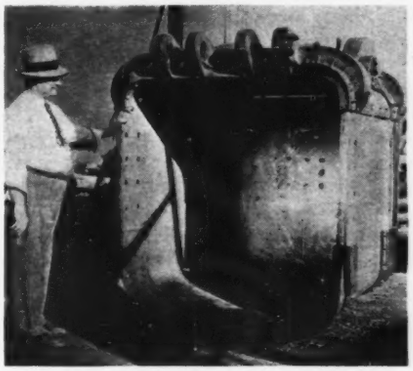
Wire rope of 18:8 nickel chromium steel is giving excellent service in marine construction and in chemical plants; it is also used in certain metallurgical operations where the resistance



BUCKET IDLER for dredge made of nickel steel; this part was transported by airplane to the New Guinea property of the Bulolo Gold Dredging Company



VIBRATING SCREENS of chromium steel are giving good service in ore-dressing plants where corrosion takes its toll



CHROMIUM-MOLYBDENUM steel is used in lips and side rims of this 4.5-cu.yd. bucket, to take the brunt of the service. Net weight of bucket is 4,300 lb., compared with 13,000 lb. for a cast-steel bucket which it successfully replaced

to oxidation and corrosion up to 1,650 deg. F. is of value. The high initial cost, however, has prevented the introduction in mines, except in some coal mines and in potash mining. High tensile strength and fatigue resistance are claimed for this type of rope. Screens of the same material are also available in all sizes.

A steady increase in the tonnage of molybdenum steels used in mining and milling equipment bears testimony of the excellent physical properties of these steels. Molybdenum not only imparts a high degree of hardness to a steel, without seriously affecting the ductility, but it also gives good depth-hardening properties, which are manifested by remarkable uniformity in heavy forged sections. Toughness, or high impact strength, is another quality of these steels which has an important bearing on the wear resistance. Molybdenum steels thus possess the qualities required in mill liners and forged roll shells. A steel found well suited for such service has a molybdenum content of 0.2 to 0.3 per cent, with chromium ranging from 0.9 to 2.0 and carbon from 0.5 to 1.0 per cent. Rolls of this material not only possess high initial resistance, but they can be used even after they have been worn down to very thin sections. Cases are on record where a shell was still serviceable after the original section had been reduced to ½ in.

Molybdenum Beneficiations

Molybdenum imparts a sluggishness to transformations occurring during heat-treatment, thus permitting the use of higher temperatures during this operation, without excessive grain growth in the austenite. It also has a tendency to minimize quenching strains. The steels have a property of retaining their strength at elevated temperatures which permits the use of higher drawing temperature, following the quench, which further reduces the strain left from quenching. The net result is high toughness and impact strength. Molybdenum is also highly effective in eliminating any tendency toward temper embrittlement, a prolific source of trouble. Comparative service records of 42x14-in. shells crushing 4-in. feed to minus 2 in. gave a life of 22 months and an output of 400,000 tons for a chromium-molybdenum unit, against 14 months and 250,000 tons for plain carbon steel, under identical operating conditions.

Forged molybdenum steels have been used to good advantage in crusher jaw plates, where tremendous impact and heavy abrasion have to be contended with. An additional advantage in such applications is that these forgings have little tendency to flow; that is, their resistance to deformation is very high. Besides, they do not change their structure under continuous impact; they are therefore especially well suited for heavy sections where ordinary manganese steel cannot be cooled fast enough to retain an austenitic structure throughout. An analysis which has worked well for crusher jaws is 0.2 to 0.3 per cent molybdenum, 1.4 to 1.6 chromium, 0.8 to 1.0 manganese, 0.2 to 0.4 silicon, and 0.7 to 0.8 carbon.

In gyratory or cone crushers, besides impact load and abrasion, an intermittent compression load occurs where refractory lumps come between cone and lining. These loads, which may be great enough to cause local distortion, call for a steel with high yield point. This quality is possessed by molybdeum steels, and, combined with comparative freedom from internal strains, it makes them well suited for this service.

Definite Mo Applications

One part of power shovels that affords a wide field for molybdenum steels is the dipper teeth. In addition to abrasion and impact loads, these are also subject to a series of sudden bending loads. A steel with 0.3 to 0.4 per cent molybdenum, 1.0 nickel, 1.4 to 1.6 chromium, and 0.45 to 0.55 carbon has been found to work well for this application. In addition to the properties enumerated, the high tensile strength combined with good ductility is of particular value in this service. When using molybdenum steel teeth it has become good practice to employ differential heat-treatment to increase ductility in the shank, as this is the point where the chance of breakage is greatest.

Shovel lips, although not subject to quite as severe service as the teeth, have also been made with molybdenum steels, with excellent results. In one case the design of the bucket as a whole was improved by using chromium-molybdenum steel in lips and side rims, to take the brunt of the service; thus the construction of the rest of the bucket could be lightened without impairing its dependability.

Shovel shafts, including raise, swing, wobbler, and drum shafts, are also subject to severe loads, and there has been a tendency toward chromium-molybdenum and chromium-nickel-molybdenum steels for this service. High resistance to torsional loads, applied gradually or suddenly; good ductility, high bending movement, great impact strength, and high fatigue resistance are the properties sought in this service. The steels used vary in analysis, and the choice depends somewhat on the size of the shaft. One recommendation for wobbler shafts is 0.15 to 0.25 per cent molybdenum, 0.8 to 1.1 chromium, 0.5 to 0.8 manganese, and 0.35 to 0.45 carbon, usually oil quenched and drawn to 350 Brinell. For shafts subject to unusual heavy loads, nickel-molybdenum steels, in a wide range of analyses, have been found highly applicable. Their air-hardening properties make them particularly suitable for parts that cannot be readily quenched.

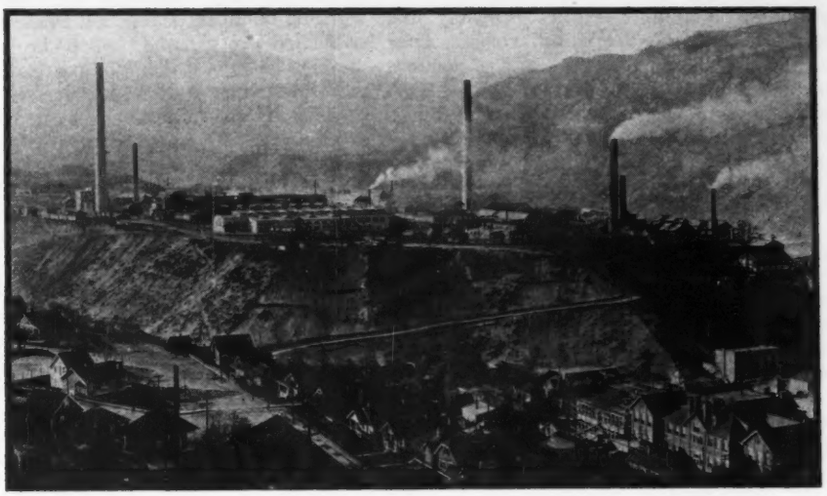
Stamp shoes, subject mainly to impact and abrasion, have been made of steel with 0.2 to 0.3 per cent molybdenum, 1.4 to 1.6 chromium, and 0.6 to 0.7 carbon, normalized and drawn to 400 Brinell or higher. Specific figures on life are lacking at the moment, but service tests show a worth-while increase.

Addition of 0.25 per cent copper to mild steel is generally made to increase the resistance to atmospheric corrosion. With proper heat-treatment a copper content of 1 per cent causes a substantial increase in tensile strength, with no appreciable loss in ductility. A number of low-alloy high-strength steels are now on the market, some of which, in addition to increased strength, possess considerably better resistance to mild corrosion than plain carbon or copper steels. For instance, a steel with 0.50 to 1.5 per cent chromium, 0.1 carbon, 0.3 to 0.5 copper, and 0.5 to 1.0 silicon has a tensile strength of 65,000 to 70,000 lb. and a yield point of 50,000 to 60,000, with a resistance to atmospheric corrosion four to six times that of plain carbon steel and two to three times that of copper steel. Another type, with 0.4 to 0.6 per cent chromium, 1.1 to 1.4 manganese, 0.6 to 0.9 silicon, and 0.15 carbon, has an ultimate strength of 80,000 lb. and a yield point of 50,000 lb. This steel can be readily fabricated by all methods, including welding, and is giving excellent service where decreased weight without loss of strength is desired. Another steel of this general type contains manganese and vanadium. Copper steels containing nickel, or nickel and molybdenum, show high strengths in normalized state and have two to three times greater resistance to atmospheric corrosion than the 0.25 per cent copper steels.

Ancient Gold Mines In Serbia

GOLD MINES in the northwestern part of Serbia on the River Pek are producing gold at the rate of about 42 oz. per day. These mines were discovered in ancient times and are said to have been worked by Alexander the Great. Mining operations have not been on regular commercial scale until recently. Some of the smaller mines were worked before the War on a small scale, but these operations were completely suspended when the miners were forced to carry arms in 1914. Operations have recently disclosed remains of crude tools and sleds buried in the gravels, which probably were used by the Romans—mute evidence of the technique employed in gold mining during those ancient days.

Many peasants in this same region, have seen the possibilities of profitable placer mining in the river gravels, and they appear to obtain as efficient recovery of gold dust with their sheepskins as the modern sourdough does with his steel gold pan.



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Time-tried cooperative committees stabilize labor relations in the leading mining and smelting company of British Columbia. Enlightened leadership provides a plan for intelligent interchange of ideas between employer and employees on matters of mutual interest

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MANY BUSINESS MEN and industrialists make the great mistake of thinking, or at least acting as though they believe, that all the brains of the nation are monopolized by themselves and those classes outside of labor. I maintain that, with the present highly developed state of nearly all industrial work, the brain of the average artisan today is fully equal, if not superior, to the average of the rest of the world. In the past, the brain of the workman and the brain of the management have often been very largely devoted to trying to outwit each other, rather than engage in attempts to cooperate. I believe it is essential that all the common ground should be explored, and that, wherever possible, men and management should work in the friendliest possible cooperation. The best way I know of accomplishing this is through cooperative committees.

Cooperative committees do not involve surrendering the rights of either the employer or the employee, but they provide the machinery for the sane consideration of the ideas of each. I am convinced that most of the dealings between employer and employee today result in leaving the parties really farther apart and more antagonistic than before. This is almost certain to be the result of conferences which are arranged only when trouble has actually come to a head.

Legislation is the last resort, in my mind, and the very worst method for handling labor problems. These problems should be discounted before they arise, and should be discussed when both parties are able to act reasonably and dispassionately.

Our company has been carrying these ideas into practice for the past sixteen years. During that time, profit sharing and other bonuses have been withdrawn when necessary and reinstated when possible. On the whole, wages have been very substantially increased. Money has been advanced to the men on favorable terms to build their own homes. Excellent hospitals have been built and equipped by the company at both Trail and Kimberley. The company has assisted, both through its influence and financially, in securing the best possible medical services, including specialist work, for the men and their families. Group insurance and pensions have been provided free of charge to the worker. The prices of nearly all supplies have increased, and yet costs have been considerably reduced. Practically every period shows a reduction as compared with the former one. These achievements have enabled our company to carry every one of its 5,000 permanent employees throughout the depression.

I have nothing against the principle of unionism. Our company was 100 per cent unionized sixteen years ago. But the men have been dropping the unions one by one, until now no union

Excerpt from Presidential Address, "Industrial Relationship," Canadian Institute of Mining and Metallurgy, Winnipeg, March, 1935. Complete address and discussion published in C.I.M. *Bulletin*, June, 1935.

men are left. The men feel that the cooperative system has greater possibilities. The Consolidated Cooperative Committees were the outcome of much study and of numerous discussions with those of the older employees who also thought there was room for improvement in industrial relations.

Unions Not Needed

Seventeen years ago, the formation of these committees was accelerated when irresponsible men got control of the local union and called a strike, in direct violation of an agreement between the company and the Western Federation of Miners, and without ever taking a vote, although about 98 per cent of the men belonged to the Federation. After the strike was declared off and work resumed, the men were invited to send representatives from every department to discuss ways and means to prevent any such situation occurring again and to improve the relations between the men and the management. Nearly every department sent representatives, and, after reviewing all the schemes we knew of and the report of the Whitley Commission in England, it was decided to form a regularly elected cooperative committee — the duties of this committee to be to help the management to run the plans fairly and safely; one man to be elected from every department by secret ballot, and, in large departments, each shift to be entitled to a representative. These men were to elect their own chairman, secretary, and subcommittees. The committee was to form a means of communication between the men and the management. No restrictions were made to deter either the men or committee members from belonging to any unions they wished. As this committee was more or less of a pioneer, it was not considered advisable to attempt to define its duties minutely, nor has occasion arisen since to indicate the wisdom of so doing. From the very first, it was evident that the scheme was not only feasible, but that it offered opportunities for much closer relationship and for far better understanding.

More than 300 men have served on these committees to date, and although every shade of opinion has been elected, even to the deepest "Red," I doubt if there are half a dozen men who have not been firmly converted to cooperative labor-handling. Without such a committee, your men are subjected to every kind of disrupting propaganda, without any counteracting agency. Once a committee becomes really established, agitators cannot sell their wares.

It must be apparent to everyone that the insecurity of the position of the "day's pay" workman is sufficient to cause unrest and dissatisfaction in an intelligent mind. A man cannot feel justified in building a home for fear of being discharged. Even the best man cannot give satisfaction to every boss under whom he may be put. Unions have always been well aware of this difficulty —it is probably the working man's greatest worry. They have tried many ways of protection, nearly always falling back to a grievance committee. Reinstatements by this method frequently leave both parties annoyed.

This worry has been entirely overcome through cooperation. A scheme has been worked out which I will describe in detail, because it has had such excellent results. Before a man is taken on, he has to pass a medical examination showing him to be in fit condition to work; he must read and understand English, in order to understand instructions and not to endanger himself and his fellow workmen; once hired, he may not be discharged just because his foreman does not like him—his foreman may discharge him for sufficient cause, but must turn in a written statement of the cause. He may, however, lay him off with an open transfer. The man then returns to the employment office, where his transfer is recorded and he is put back with another foreman at the first opportunity. If given a second open transfer within two years of the first one, he is warned that a third open transfer within two years means that he is automatically discharged. Records of open transfers are removed from the books at the end of two years.

Handling Grievances

Since this scheme has been developed, grievances are extremely rare, and those which do arise are generally settled by the committee. Unsatisfactory men are undoubtedly kept longer than they should be, but good men know that they are secure as long as they perform their work; consequently, the labor turnover has been reduced to a fraction of 1 per cent per month.

Should a man feel that he has been unjustly treated, he must take his case to his representative on the committee. As the committee is working in cooperation to insure justice for both parties, results are obtained with a minimum of ill-feeling.

The cooperative committee investigates and advises on all relief cases. It apportions relief work among the needy. It appoints subcommittees to look after the medical and hospitalization contracts, safety work, workmen's garden plots, picnics, sports, and, in fact, all the activities of the workmen.

One of the most important and valuable functions of the committee is in educational work. Accident prevention is an example. The number of shifts lost per 1,000 shifts worked has been reduced in fifteen years from about 15 to 3, and in the same period fatalities have been reduced from 1 in 800 man-years worked to 1 in 2,500 man-years.

I would warn anyone who may be contemplating the establishment of such a scheme that the first essential of success is to play a full 100 per cent fair with his committee. He must give them full parliamentary privileges and immunity. He must give the fullest consideration to the suggestions of the men, and, when he has to decide against them, he must give them his reasons for doing so. He should give them as much authority as he can. Our committee has proved invaluable both to the men and the company. The fairness of the men who serve on it has convinced me that if industries generally adopted this scheme, the working man would learn that universal employment depends largely on bringing the wages of the various industries more nearly into line. I am certain there would be a decided tendency on the part of the men to stop trying to increase wages and shorten hours in those industries in which wages are already high, and a willingness to help raise the wages of those who are underpaid.

It is quite possible, and in fact probable, that history will again repeat itself and that working hours generally will be shortened. Undoubtedly the world, if employed, can produce all its needs and much luxury with shorter working hours. A future balance will be struck, in the main, on a division of the amount of luxury a man desires and the work he is prepared to do for it.

At least 90 per cent of the laboring population are fair-minded and reasonable, a fact which should always be kept in mind by everyone handling labor problems. The difficulty of the employer is to reach this 90 per cent. In most cases, these men allow the other 10 per cent to do the talking for them. The cooperative committees form a very fine method of interchanging ideas. The interests of a company, its management, and its men are practically identical in everything except wages, and although, in the matter of wages, their interests might at first sight appear to lie rather in opposite directions, this is not actually the case. Low wages rarely yield good or cheap work, and high wages alone, without good working conditions, rarely make satisfied workers. The ideal situation obtains when the management and the men can meet and discuss all problems on friendly terms, and when the management makes the position of the working man secure and comfortable.

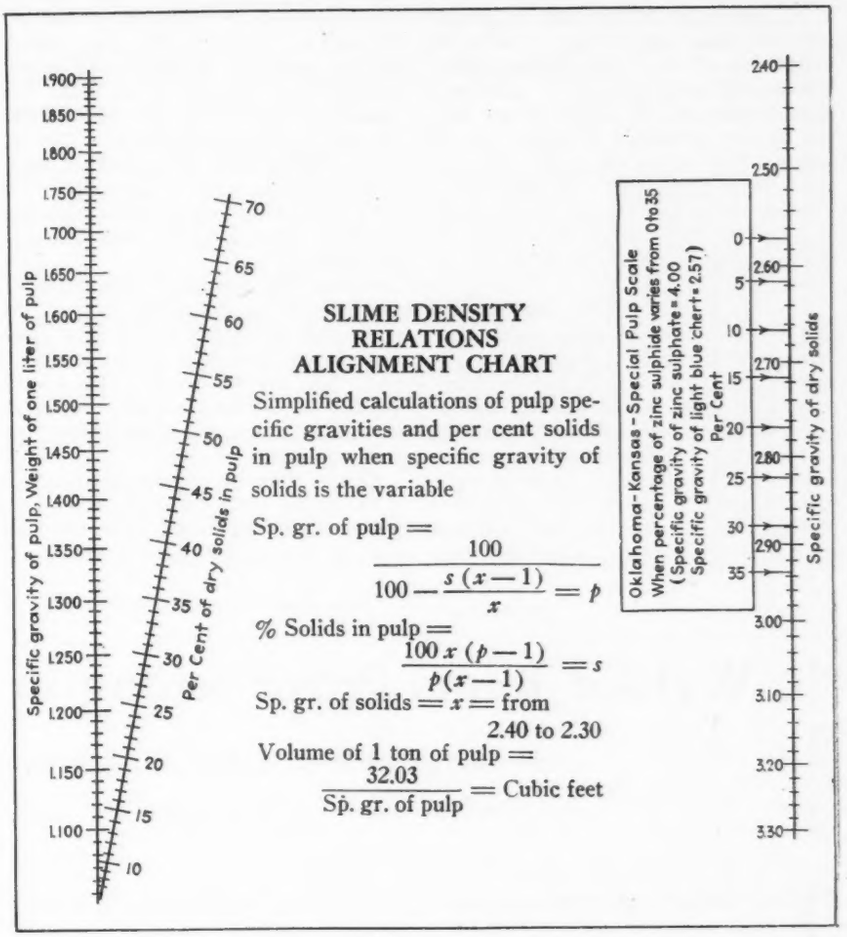
"Human" Engineering

Every capable engineer tries to protect his plant and machinery from all disintegrating forces; surely it is even more important that he should provide equal protection for his workmen. He will fight for a good factory or a good engine house. Why not for good housing for his men and their families, for good schools, good medical service, good hospital accommodation, a share in the profits, bonuses which will insure their interest in the work, permanency of employment, and a pension when a man's working days are over? He will almost certainly find that these benefits, far from costing his company money, will develop reduced operating costs, a stable community, and a happier personnel.

A Nomograph for Calculating Slime-Density Relations

Fundamental pulp formulas are quickly solved with this alignment chart

C. E. Heinz
Metallurgist,
2333 Wall St., Joplin, Mo.



HYDROMETALLURGISTS appreciate the excellent pulp-density tables prepared and published by Clevenger, Caldwell, Lamb, Sharwood, Hyder, Allen, McLain, and many others. Perhaps the tables prepared by Lowden and published in *Metallurgical and Chemical Engineering* in the June, 1912, issue, are best known to most readers. For laboratory and office calculations these tables have proved of great value, as time savers. However, the carefully prepared tables, when used for plant problems, do not always check plant results. The discrepancy in the figures could be traced to several causes. If one assumes that the plant data have been accurately determined, the principal reason why the office and plant figures may differ may be traced to the fact that the tabulated slime tables lack "the action picture" of slight changes that may occur in the specific gravities of the solids in the pulp as it travels through the circuit.

Slime-table data are usually prepared from fixed specific-gravity constants for solids in the pulp in terms of units and tenths, such as 2.40, 2.70. For more precise calculations, one may interpolate from the figures given in tables. However, when the percentage of dry solids in the pulp is in the higher brackets, and the time factor or volume factor (or both) increases rapidly, the final mathematical results may be very much in error.

In a cyanide flowsheet, but little change occurs in the specific gravity of the solids in the pulp. In flotation pulp problems in practice, when "rich" feeds are treated, much difference takes place in the specific gravities of the solids in the pulp as it travels through the circuit. For example, a Kansas-Oklahoma freshly prepared flotation feed could be composed of 14 per cent by weight zinc sulphide and the remainder of the solids could be a "blue-white" chert. The specific gravity of the zinc sulphide is 4; that of the chert, 2.57. The solids when mixed in the flotation feed have an apparent specific gravity of 2.70. Now let us assume that the tailings from this plant contain 1 per cent zinc sulphide by weight. The specific gravity of the solids is now only 2.578. One will see that there is no small difference in the specific gravities of the dry solids in the feed and tailing of this circuit.

To supplement all slime-pulp or density tables, within certain limits, and perhaps take the place of many tables of this nature, the accompanying alignment chart for rapid calculation has been constructed. This type of chart produces in graphic form the fundamental or base formulas for calculating the percentage of dry solids in any pulp when the specific gravity of the solids in the pulp and the specific gravity of the pulp are known. Knowing any two of these three variables, the third is read direct from the chart.

This chart appears to have the ability to picture, present, and convey to the user the importance of correcting what would usually be considered minor

errors in pulp calculations. It has been found valuable for office and laboratory computations, and the formulas presented in this manner have the added feature of being most practical, because the chart is workable by both technical and non-technical mill employees.

The accuracy of the chart is greater than the usual interpolations necessary in the use of most pulp-density tables. The density of a pulp under consideration, in terms of the weight of one liter, can be read to within 5 grams, plus or minus. This is an allowable error for plant specific-gravity determinations. The conversions of the "specific gravity of pulp" to "percentage dry solids" in the pulp can be read to within plus or minus 0.10 per cent.

The chart has an additional feature that should prove of more value than many published pulp tables. With it the specific gravity of a solid may be determined, or used, to the second decimal place, and the range is from 2.40 to 3.30.

A special "Oklahoma-Kansas" zinc district scale is included as an example of what could be incorporated on a chart of this type in other districts. Where comparatively simple or consistent ores are being treated, the percentage of certain minerals can be calculated by density determinations, provided the specific gravities of the two major group minerals are not too near alike. Where "rich" feeds in a flotation mill are being treated and when the gangue minerals are consistent in composition, the percentage by weight, of the zinc sulphide in this case, can be determined rapidly from the dry weight of the pulp. This method of estimating the zinc sulphide content is not as accurate as a chemical determination, but the calculated figure read from the chart could be of value as a time saver and of much assistance in plant control, until checked by the laboratory.

A working example of the procedure outlined in the foregoing follows: Assume that the flotation feed is a simple ore, being composed of zinc sulphide and "blue-white" chert. The specific gravity of the pulp is 1.400. When the sample is dried, it contains 45.20 per cent dry solids.

On the chart, pass a straight line from 1.400 on the left-hand scale, through the point where 45.2 would be on the "percentage dry-solids" scale of the oblique line, and continue the straight line over the right-hand scale. On the right-hand scale one reads the "specific gravity" of the solids in the pulp, and on the special scale, 15.00 per cent zinc sulphide.

Suppose that this sample were taken from the tailing discharge of this plant and that the percentage dry solids was found to be 46.8 per cent by weight. Passing the straight line from 1.400, through 46.8 to the right-hand scale, one reads 2.578, the specific gravity of the solids in the pulp, or the zinc sulphide content, from the special scale, reads 1 per cent.

The best way to read alignment charts, for the greatest accuracy, is to use a piece of clear celluloid strip or a triangle, with a straight line scratched in about $\frac{1}{8}$ in. from the edge. Lay the scratched straight line down on the chart. A string or thread is also useful.

This chart can be modified to calculate "water ratios," "weight of water," "volume of water or pulp," "displacement of one fluid ton," and several other slime-density formulas, if desired. However, the basic formulas plotted cover the major pulp- or slime-density calculations.

Welded Joints Prove Strong in Pump Column

Leaks Entirely Obviated in Installation Raising 2,500,000 Gal. Per Day, in Successful Operation for More Than a Year

TWO and one-half million gallons of water was being pumped daily from a Southwest lead and zinc mine, but, despite this, an hour's breakdown of only one of the pumps would have had serious results, the existing installation being inadequate. Conditions called for drilling a hole to the 1,200-ft. level to accommodate a 12-in. water column and for installing new and more powerful pumps.

Because of the size and length of the column, the engineers of the mine management sought to insure a long life for it. They decided that all the joints in the casing be oxy-acetylene welded, so that the joints would last at least as long as the rest of the pipe. Although welding had been employed at this mine for general maintenance, the company called in an oxy-acetylene service operator for the special work.

Inasmuch as the borehole was so located as to strike a drift at the 700-ft. level, it was decided to carry the casing down to this drift, run it horizontally for 500 ft., and finally carry it down another 500 ft. through a vertical shaft that was to be sunk from the 700- to the 1,200-ft. level. To save space, the horizontal part of the line was to be hung from drift roof.

When the service operator arrived, he aided in designing a jig for holding the 12-in. pipe and in fabricating a special clamp for aligning the sections. The pipe ordered was 49-lb., $12\frac{3}{4}$-in. O.D. steel casing, tested to a pressure of 900 lb. per square inch. The operator instructed the two men who were to do the job in the proper welding technique, and under his supervision they were soon able to make good welds with the pipe in a vertical position. Their first task was to cut and weld to the bottom joint a bull plug point with a 2-ft. taper to act as a guide for the casing. The two men worked together on the same joint, welding simultaneously on opposite sides of the pipe. In spite of their inexperience, they completed six welds at the end of the first day, so that seven 20-ft. lengths had been joined together. On the following day six more were completed, making a total of 260 ft. of continuous piping. All the welds were made with High Test steel welding rod.

In lowering this 260-ft. string of pipe, it was accidentally dropped and it fell 340 ft. before striking bottom. The only damage done was to the point on the bottom, which was a splendid test of the strength of the welded joints. The welders finished the 650-ft. column successfully without further delay.

A short nipple with a high-pressure flange was welded to the bottom of the column. To this was bolted a high-pressure cast steel spool or Y connection, within which a packing gland was installed. This was to provide an exit for a 2,300-volt lead-covered cable that was to run inside the pipe to the 650-ft. level. The cable was to supply power to the two new high-pressure pumps installed at the bottom of the shaft.

The service operator demonstrated in the shop how to fabricate bends in the pipe, as a four-piece 90-deg. ell was to be installed on the bottom of the column. The ell was beveled at one end and provided with a flange on the other.

After he was sure that the welders were capable of completing the job without further instruction, the service operator left the remainder of the work in charge of the mine superintendent. This work, being of a nature similar to that which was just finished, was successfully completed.

The installation has been in successful operation for more than a year. From the start, according to the superintendent, all the joints were absolutely without leaks. As the pressure at the bottom of the column is estimated to be 485 lb. per square inch, this performance is thought remarkable.

Nickel . . . and the United States

A Brief Survey of the Country's Present Position With Respect to This Essential Commodity

G. W. Pawel
Room 3404, Chanin Building, New York

The world's largest consumer of this metal and its alloys finds itself dependent on Canadian supplies . . . only one plant remains representing a formerly prominent domestic industry . . . Nevertheless, in addition to the once-worked and perhaps limited resources of certain states, there are ore occurrences of probable importance, although but little developed, in the southeastern part of Alaska

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MUCH ATTENTION has been paid of late to "strategic" or "deficient" metals in the United States. In any consideration of this subject nickel is always given a position of prominence with chromium, manganese, tungsten, and tin (*E. & M. J.*, Jan., 1935, p. 7). The report of the Planning Committee for Mineral Policy refers to "outstanding deficiencies in domestic supply" of these metals, and recommends public encouragement for exploration in search of additional sources within the country. In view of the fact that the United States is the principal market for nickel, although now producing none, it is worth while to examine the present situation, the recent history of the nickel industry in the United States and its gradual disappearance, and the prospects for the future domestic production of the metal. The following notes are a summary of my extensive collection of data on the general nickel situation with respect to the United States.

From comparative rarity to its present important place, the rise of nickel is covered by the life span of many still among us. For, though the modern history and use of nickel may be said to have started with the small-scale manufacture of german silver in Europe around 1830, the real commercial consumption of the metal hardly began until the opening of the New Caledonian deposits, about 1875, providing the world with a plentiful supply of nickel hitherto not available. Previous to 1875 the world's demands had been met by the output of several small producing mines in different localities, principally in Germany, Norway, and the United States. This production was promptly curtailed on the exploitation of the rich New Caledonian ores, and they, in turn, were eclipsed later (1886) by the far more extensive orebodies of the Sudbury district of Canada.

Numerous Nickel Alloys

Though nickel is not the most important of the non-ferrous metals from the tonnage standpoint, it is hardly surpassed by any of them in the importance and diversification of its applications. It is now used in preponderant proportion for peace-time purposes, and yet its importance as a war material cannot be overestimated.

The greatest tonnages of nickel are used in its many combinations with iron; especially in the high tensile structural steels for automotive assemblies. Large quantities are also consumed in the newer "stainless" corrosion- and heat-resistant irons and steels for many purposes, as well as in preparing the magnetic and non-magnetic irons, electric resistance metals, low thermal-expansion alloys, and high-strength nickel cast irons and steels.

As a non-ferrous product, nickel again plays a most important rôle in its innumerable combinations with different elements for the production of alloys. Among these are nickel silver, Monel metal, and silveroid, used largely for ornamental purposes, the lower cupronickels for condenser tubes and deep-drawing applications, and also the 25/75 nickel-copper composition used widely for coinage. There are many minor alloys in each of which nickel contributes one or another of its peculiar properties of strength or toughness, corrosion, electric, or temperature resistance, and color, and each of which alloys has some more or less important application. In fact, nickel lends its properties to a more varied and useful number of alloys than any other single element with the possible exception of iron.

Besides its use in many ferrous and non-ferrous combinations, nickel is also employed for many purposes as the pure metal. Nickel plate is probably the best known of these, although pure nickel enters in large quantities into many chemical and dairy assemblies, vats, tanks, and cookers, in some places where scarcely any other metal will suffice. Appreciable quantities are also absorbed by the radio or vacuum-tube industry.

Coinage is taking increasing quantities of the pure metal, and many countries have adopted nickel for this purpose. This increasing tendency for building up a pure nickel coinage is not surprising, for the obvious reason that a store of nickel in this form constitutes a readily accessible reserve in time of need.

Finally, nickel salts and compounds are consumed in considerable quantities for various purposes, but notably in the production of Edison storage batteries, in nickel plating electrolytes, and as catalyzers in hydrogenation work.

Of all of such industries devoted to the production and use of these nickel-consuming alloys, the United States has its full share. So much so that our country normally absorbs well over half of the entire world's nickel output. This amounted to about 40,000 tons in 1929, valued at some $20,000,000, having risen steadily from a low point in 1921, when because of the cessation of the World War and the limitation of armaments as a result of the Washington Naval Conference, the use of nickel approached the vanishing point.

During the depression, the demand again fell to low figures, but it is significant that the world's nickel consumption last year (70,000 tons) exceeded that of the peak of 1929. In view of the huge naval building program to which we are committed, and with the constantly increasing use of the aforementioned alloys of nickel, a steadily mounting demand is to be expected.

Purity, Price, and Production

Most of the metal on the market today, be it electrolytic, Mond pellets, or Belgian cubes, shot or ingot, is all well above 99 per cent purity, and a large part of the nickel now being offered to the trade is of a standard of purity com-

parable with that of the analogous grade of copper, aluminum, zinc, or any of the tonnage metals.

Following the opening of the New Caledonian deposits (1875), the price of the metal, which had fluctuated between $3.85 and $1.10 a pound, dropped precipitately as the large potential supply became available at the time when the world's absorptive capacity was scarcely more than 500 tons a year. Some ten years later, the active exploitation of the Sudbury district began, and with the knowledge of such huge reserves of nickel so conveniently at hand it became increasingly desirable that markets be found for the additional tonnages available. The problem was solved just before the turn of the century by demonstrating to the United States and foreign governments the unquestioned superiority of nickel steels over plain carbon steels, especially for armament purposes.

The advantages of nickel additions to iron had been recognized by different investigators for many years prior to 1890. The story of the rise of nickel steel, however, can form no part of this summary. Its effect on the consumption of nickel may be seen readily by a study of consumption-production and price statistics, some of the high spots of which are given in the accompanying table.

Nickel Consumption-Production and Price Statistics

Year	Tons	Price	Year	Tons	Price	Year	Tons	Price
1875.....	600	$2.50	1913.....	34,000	$0.40	1922.....	10,000	$0.25
1885.....	1,000	0.70	1915.....	42,000	0.40	1925.....	40,000	0.35
1890.....	2,600	0.65	1917.....	50,000	0.50	1929.....	62,000	0.35
1895.....	4,500	0.37	1918.....	52,000	0.50	1930.....	44,000	0.35
1900.....	9,000	0.50	1919.....	26,000	0.35	1932.....	28,000	0.35
1905.....	15,000	0.40	1920.....	34,000	0.35	1933.....	49,000	0.35
1910.....	23,000	0.40	1921.....	10,000	0.30	1934.....	70,000	0.35

The figures presented in the table speak eloquently not only of the increasing consumption of nickel but also indicate the years of high and low industrial activity. Similarly, the price variation over the years, as shown in the table, also throws an interesting light on the vicissitudes of the nickel industry.

About 90 per cent of the nickel production shown in the later years in the table originated in Canada and represented the production of one or two companies only. The New Caledonian field has been accounting for some 4,000 or 5,000 tons a year even during the depression period. It is due to the almost complete domination of the world's nickel situation by one or two companies that the selling price of the metal has for years been maintained at or near its present price of 35c. per pound, in spite of the strong fluctuations in supply and demand noted in the foregoing.

Although nickel occurrences have been reported from nearly every country on the globe, no relatively important ones are now being worked save those of Sudbury and New Caledonia. Some of the more recently discovered deposits of interest are in the Transvaal, Brazil, Korea, Siberia, Finland, Manitoba, Hudson Bay, British Columbia, and Alaska. The last four named discoveries, in a chain from Sudbury to Alaska and across the northern hemisphere, are for the most part sulphide ores of the Sudbury type. Deposits in the more tropical areas in Brazil, Cuba, New Caledonia, and Madagascar are of the oxidized garnierite type ores. The nickel-chromium carrying Mayari iron ores of Cuba are of immense extent, and these as well as the lesser developed resources of Brazil may in time account for an appreciable output. Nickel deposits of Finland noted in the press not long ago will bear watching, although it seems unlikely that this area will be strongly developed by the concessionaires for some time.

The United States at present records no production from native ores. An indication of our lamentable contribution to the nickel picture is contained in the last issue of "Mineral Industry," which gives the total amount of nickel recovered in 1933 in the United States at 126 tons as a byproduct in the electrolytic refining of copper. The record further tells us that in 1929 the United States consumed some 40,000 tons of nickel and produced 340 tons as a byproduct! This condition, however, did not always obtain. Up until 1921 the United States was the most important factor in the refining of nickel. Americans were largely instrumental in the opening of the Sudbury deposits, and for many years most of the Sudbury mattes were refined in this country, as well as a proportion of the New Caledonian material. The question of these refineries will be taken up later. First let us look into our own nickel-mining history.

Early Domestic Nickel Mining

To mining men it is interesting to note that probably the first metal mine operated by the American Colonists (save for iron and gold workings) was a nickel deposit! The reference is to the mines near Chatham, Middlesex County, Conn., less than 100 miles from New York City, worked (1661) by John Winthrop, first American chemist and metallurgist and first Governor of Connecticut, who believed the ores to contain silver because of their white or silvery color, nickel not becoming known as an element until 75 years after his death. Since Winthrop's day various attempts have been made to put the Connecticut mines into production, and we find that this was accomplished at several periods down the years. However, they did not attain the production record achieved by the Lancaster Gap mine, referred to hereafter. It might be well to observe in passing that, though these properties have had an intermittent development of nearly 300 years, and in all probability are of very limited extent, they have never enjoyed the benefit of modern methods of exploitation, and it would be interesting to see what geophysical prospecting, diamond drilling, and flotation concentration would show for this particular area.

Pennsylvania and Missouri Deposits

The Gap mine referred to is about 15 miles east of Lancaster, Pa. It was discovered in 1718 and was irregularly operated for recovery of copper until 1852, when it was found that the ore contained nickel. It was then worked for this metal unsuccessfully—probably because of lack of knowledge of proper refining methods—until taken over by Joseph Wharton, of the American Nickel Works, in 1863. From then on until it was shut down in 1892 it supplied ore continuously for the Wharton Works, and during most of that time was one of the important nickel mines of the world. The ore carried from 1 to 3 per cent nickel and a small quantity of cobalt, and was worked down to about the 300-ft. level, when it was said to be exhausted, although this statement has been repeatedly questioned. In its 30 years of operation the mine produced an estimated 3,000 tons of nickel and employed on an average about 200 men.

Another mining area which shared with the Gap mine the distinction of having a favorable record of nickel production within the United States includes the Mine La Motte and Fredericktown (Missouri) deposits. Here the nickel occurs in a complex ore containing cobalt, lead, and zinc, which has been difficult to refine profitably except during periods of high prices for nickel and cobalt. Mine La Motte is said to have been worked as early as 1719 by the French explorers and was operated for recovery of its nickel and cobalt values prior to 1857. Also, the North American Lead Company made an attempt to get into nickel production in 1907, and produced about 250 tons a year until 1910, when it became involved in litigation and discontinued work. The record also shows that other companies have worked the properties for nickel and cobalt in past years.

Hence it is clear that previous to the

development of the huge deposits at Sudbury, the United States had a respectable domestic nickel-mining industry, with mines at Lancaster Gap and in Missouri, with an annual output of nickel averaging about 200,000 lb. a year between 1870 and 1890. That production came from American mines alone, and though it is not an impressive figure compared with present standards, it represents during much of the period as much nickel as the country needed for its own requirements.

Besides the deposits in Pennsylvania and Missouri, other promising finds were made in several other parts of the country. Notably, the ones near Riddle, Ore., and those in Nevada and North Carolina underwent some little development. In Oregon four different companies were reported to be operating at one time in the 1890's, but they all were said to be handicapped by lack of railroad transportation. Perhaps their inaccessibility was a large factor in their failure to develop, but it is more likely that the deciding one was the competition of the Canadian ores which were then being treated in the United States.

Deposits were also reported at different times from Arizona, California, Washington, Virginia, Arkansas, Iowa, Massachusetts, Colorado, and elsewhere, and from several places in Alaska. In late years the Alaskan deposits have aroused the most interest. Undoubtedly they hold the greatest promise because of the number and reported size of the occurrences and the favorable notices they have repeatedly received, especially in Government bulletins.

The best known of these ore deposits lie in the Alexander archipelago of Southeastern Alaska contiguous to Juneau and the Juneau gold belt. Good showings and in some instances considerable development have been reported on several of the adjoining islands—notably, Admiralty, Chichagof, Yakobi, Baranof, and Fleming Islands, and elsewhere. In all cases the ores are sulphides of the Sudbury type, and usually associated with norite or similar basic rocks, as in the Sudbury basin. They resemble also the recently opened nickel-copper orebodies of British Columbia a few hundred miles to the south, and the assays given for both ores are comparable, as might be expected. In neither field are the ores as consistently high in nickel content as those at Sudbury, showing in general from 1.5 per cent nickel. But they are also much leaner in iron content, as well as copper, carrying less pyritic minerals, and, therefore, would undoubtedly yield a richer concentrate than is possible with the more pyrrhotitic ores of Sudbury. It is largely this fact which lends hope and good prospect of handling successfully what one Government geologist calls "the lodes of disseminated type ores which occur in considerable volume in Alaska."

I visited this region in 1933 and spent several weeks in a personal examination of some promising orebodies, especially on Admiralty Island, where exploratory and development work has been carried on for several years. An estimated 5,250,000 tons of ore have been blocked out by tunneling and diamond drilling in an olivine-diabase dike some 180 ft. wide and of undetermined length, although the outcrops could be followed for a considerable distance in both directions.

The layman associates the name of Alaska with icebergs, glaciers, and eternally freezing temperatures. This may be warranted for certain parts of the country, but the southeastern coast line, where the nickel deposits are found, warmed by the Japan Current, enjoys reasonably mild weather the year round, and the deep waters and good harbors are open for ocean-going vessels at all times. For this as well as other reasons the mining conditions in this district are distinctly favorable. The accompanying view was taken in March, 1935.

Though only a few years ago refineries in the United States accounted for the greatest part of the nickel produced in the world and gave employment to many American workmen, the present time finds no nickel ore or matte refineries producing nickel here. There are no custom refineries for handling nickel ores or mattes if any supply of these were developed. The question might well be asked, might not some of the old prospects be opened and an incentive given to developing new finds if the country afforded a custom refinery for purchasing and handling such ores? Perhaps foreign ores or concentrates, or both, might also be attracted, and in addition a conveniently located custom refinery could handle the country's nickel scrap and drosses, which now go largely to Germany for recovery of their values.

The first American nickel refinery of note was Joseph Wharton's plant at Camden, N. J., referred to previously. This was in all probability an outgrowth of Booth's Philadelphia refinery (1846) and of the one erected by F. M. Buck and E. W. Coffin at Camden in 1853.

Wharton's important work seems to have begun about 1863, when he leased the Camden works and the Gap mine and started production of nickel and cobalt and their salts. These operations continued for about 30 years, during which time he produced around 100 tons of nickel a year, largely from the ores of his Gap mine. Following 1890 the Sudbury mattes began to come in, and these gradually displaced all other raw material until 1902, when the company, having been absorbed into the International Nickel merger, transferred its

A NICKEL DEPOSIT in southeastern Alaska. Panoramic view of property of Admiralty-Alaska Gold Mining Company, on east side of Admiralty Island, 15 miles from Juneau. The water is Funter Bay, a deep harbor open to navigation at all seasons. In the photograph, "A, A" mark the outcrops of the nickel-bearing lode; "B" (at 1,700 ft. elevation) indicates the tunnel tapping the lode and the main workings. The latter point is connected with the mill, "D," by an aerial tramway, "BC," and a level narrow-gage railway 3,000 ft. long. The mill is equipped also to handle the gold-silver ores occurring on the property. At the time of taking the photograph (March, 1935), some snow remained on the mountain top, which is about 2,800 ft. high.

work of nickel refining to the larger plant of the new organization at Constable Hook or Bayonne, N. J. The Camden establishment was abandoned in 1912.

The American Nickel Works had an interesting career and will undoubtedly be carried in the records as the pioneer of the nickel industry in America. Joseph Wharton was certainly responsible for many of the early developments in nickel metallurgy, and probably it was at this plant that nickel was first commercially malleabilized. Wharton's display of a line of fully malleable nickel products at the Vienna Exposition of 1875 and at the Centennial Exposition at Philadelphia in 1876 was far in advance of the field and is said to have proved somewhat of a sensation. Those of us who much later struggled with the problems of commercially malleable nickel can testify that Wharton's work was an achievement worthy of place even among such assemblies of the most notable and distinguished exhibits of the time.

Canadian Matte Refined in U. S.

The magnificent plant of the Orford Copper Company, built at Bayonne, N. J., soon after the opening of the Sudbury district (1886), was by far the largest nickel refinery in the country or in the world. For many years it handled the bulk of the mattes produced by the Canadian Copper Company, or until its abandonment in 1921, when all nickel refining of the International Nickel Company was removed to the new plant at Port Colborne, Ontario, not far from Buffalo. This transference of all nickel-refining operations from the United States to Canada came about after twenty years of more or less continuous and logical agitation for home refining of Canadian ores. The long-felt desire to save for the Dominion all the benefits of complete refining from ore to ingot culminated during the World War in the recognized necessity for absolute control of the Empire's nickel resources by the British Government. A rigorous surveillance by foreign accountants had early in the War been placed on all shipments of metals from the Bayonne refinery, and later this control of nickel supplies was tightened by a Canadian embargo effectually preventing deliveries of nickel materials to destinations other than to the British Empire and its Allies. The mattes for refining at Bayonne, however, were permitted to enter the United States under special license. Otherwise, there being no adequate refining capacity in the Empire at the time, the supply of finished nickel for Allied requirements would have been seriously curtailed. Shipments of metal even for our own mills and factories required the permission or approval of the British Government. Finally, as a result of the insistent pressure, both public and official, the new refinery at Port Colborne was authorized in 1916, and the starting of operations there in July, 1918, marked the beginning of the end of what for many years has been a substantial industry in the United States.

Another much smaller nickel refinery, that of the United States Nickel Company, was erected at New Brunswick, N. J., in 1910 for the purpose of securing a share of the American nickel market. It was a branch of a French concern operating also in France and Belgium, and was designed for handling the nickel-iron mattes from New Caledonia. The company operated for about twenty years, producing from 2,000 to 3,000 tons of nickel annually, and its closing early in 1930 left the domestic market solely to the Canadian refiners of the Sudbury ores.

The English Mond Nickel Company, searching for an outlet for its excess production in the very thin markets of 1921, turned its attention to the United States and took over the defunct plant of the Nickel-Alloys Company at Clearfield, Pa., which had previously been operated as a ferrous and non-ferrous rolling mill. The plant was completely rehabilitated by the Monds, and for a number of years they continued the business of rolling and drawing nickel and its alloys into all forms. Following the consummation of the merger of the Mond and International nickel companies late in 1929, this plant also shut down and followed its predecessors into oblivion.

Two other plants, the Canadian Copper Works, erected near Cleveland in 1891, and the Balbach Refining Company, at Newark, N. J., at one time also refined appreciable quantities of nickel from Sudbury mattes, but both these companies long since ceased operations.

There remains, therefore, only one company now in the United States operating exclusively on nickel and its alloys. The reference is to the International Nickel Company's plant at Huntington, W. Va., where no nickel is refined but where Monel metal is produced, and it, as well as pure nickel and numerous alloys, are rolled into shapes, as was done at the Mond plant at Clearfield previously mentioned.

Tariffs on Nickel

Previous to 1885, when the country's nickel requirements were being supplied largely from native ores, the import duty on nickel ores and mattes was at the rate of 15c. the pound of nickel contained. Later, on the plea that nearly all the Sudbury nickel mines were owned by Americans and that the import duty was discouraging to refining developments in the United States, Congress was importuned to permit free entry of nickel ores and mattes. This was granted by the McKinley tariff schedules of 1890, and since that time nickel raw materials have been entering the country free of duty. The refined metal has always carried a certain impost, the tariff of 1883 levying a toll of 15c. plus 35 per cent ad valorem on pure nickel or high nickel alloys. This was gradually reduced and was held at around 6c. a pound during the years when the bulk of the nickel production centered in this country. Following the transfer of refining to Canada and the shutdown of the last important refinery here in 1921, the import duty was reduced to 3c., at which point it has since remained.

Summary

In conclusion, I have attempted to present some condensed information on the most pertinent and significant facts dealing with nickel, especially its relation to the United States. These facts serve to indicate that nickel

1. Is one of the most useful metals in American life today

2. Is almost indispensable in peace time or war

3. Is expanding its uses every year

4. Is found widely distributed throughout the world but has been extensively developed only in Canada and New Caledonia

That the United States

1. Normally consumes more than half the world's output

2. Imports practically its entire requirements

3. Formerly was the center of nickel refining, but now has no matte-refining capacity whatsoever

4. Has several promising deposits, particularly in Alaska

5. Could employ thousands of American workmen in an American nickel industry, if only for supplying its own requirements.

With these facts in mind the reviving of the American nickel industry would appear a worthy goal, warranting our serious consideration and earnest effort. Certainly it presents a picture abounding in interest and possibility, appealing to the imagination and to realism, and offering a challenging problem for American courage and resourcefulness.

NEWS
OF THE INDUSTRY

RFC Appoints Six Mining Engineers to Assist Applicants Seeking Mine Loans

Mining States Grouped Into Six Regions, Each Having a Supervising Engineer to Report Development Progress

TO ASSIST applicants for loans for the development of small mining properties, the Reconstruction Finance Corporation has appointed supervising engineers in six mining regions. The areas, the engineer appointed, and his headquarters are as follows:

Arizona-New Mexico, William B. Gohring, Phoenix; California, B. M. Snyder, Los Angeles; Colorado, Howard N. Lary, Denver; Nevada, Roy A. Hardy, Reno; Montana-Idaho, August Grunert, Helena; Oregon, Washington, and Alaska, Alton E. Klitz, Portland. Mr. Klitz also will have an office in Juneau, where he will spend a part of his time. These men, with former Senator Tasker L. Oddie, are the only mining representatives the RFC has in the field.

Though it is contrary to the policy of the RFC to allow those in its service to prepare applications for loans, the supervising engineers will give all necessary guidance to prospective applicants.

When an application for a development loan is found to be promising by the mining section in Washington, the supervising engineer for the region will be asked to examine the property. If the loan is granted the applicant will be required to pay the actual cost of the examination. If the application is rejected the costs will be paid by the RFC. This policy was adopted when it became evident that very few of those applying for the development loans are in a position to pay for the examination of their property. All examinations of properties covered by Class A loans will be made as heretofore by mining engineers resident in the locality, selected by the RFC but paid by the applicant.

When the money is advanced for a development loan the regional engineer or someone he will name will visit the property each two weeks and make a progress report. The purpose of this frequent inspection is to make sure that the money is being used to the best advantage. A condition of the loan is that the borrower accompany the RFC engineer on these inspection trips if at all possible.

Up to Sept. 1 applicants for Class A loans had reported $32,000 paid out for engineering services in connection with RFC examinations.

List of R.F.C. Loans Approved for Mine Development and General Equipment

Applicant	Amount	Location	Date Approved	Purpose of Loan
Sutro Tunnel Coalition, Inc.	$160,000	Storey Co., Nevada	10/ 4/34	Construction of a mill
Cram's Incorporated	12,000	Crook Co., Oregon	11/19/34	Retorts, equipment and supplies
Southwestern Metal Mines, Inc.	8,000	Yavapai Co., Arizona	11/19/34	Power line and pumps
Gold Hill Dredging Co.	240,000	Placer Co., Calif.	1/17/35	Dredging equipment
Consolidated Coppermines Corp.	3,000,000	White Pine Co., Nev.	1/21/35	Mill and mining equipment
Porter Bros. Corp.	180,000	Lewis-Clark Cos., Mont.	1/21/35	Dredge
Thos. R. Hanna	8,000	Mono Co., Calif.	1/31/35	Milling equipment
Guy M. Standifer	350,000	Sacramento Co., Calif.	3/21/35	Dredge and power line
Picacho Gold Mining Co.	350,000	Imperial Co., Calif.	4/ 9/35	Mill and mining equipment
Dayton-Douglas Cyanidation Co.	15,000	Lyon Co., Nev.	4/ 9/35	Milling equipment
Humphreys Gold Corp.	250,000	Madison Co., Mont.	4/ 9/35	Dragline equipment
Mining & Development Corp.	176,000	Grant Co., Ore.	5/ 3/35	Mill and mining equipment
Sacramento Gold Dredging Co.	140,000	Sacramento Co., Calif.	5/ 9/35	Dredge
Haughey & Haughey	10,000	Wilkes Co., Ga.	6/26/35	Gravel washing equipment
Harqua Hala Gold Mines Co.	750,000	Yuma Co., Ariz.	6/26/35	Mill and mining equipment
S. A. Guiberson, Jr.	25,000	Plumas Co., Calif.	6/26/35	Gravel washing equipment
Tuolumne Gold Dredging Corp.	630,000	Stanislaus Co., Calif.	6/26/35	Construction of a mill
R. Robert Meier	8,000	Cochise Co., Calif.	6/26/35	General equipment
Mill Tailings Recovery Co.	100,000	El Paso Co., Colo.	7/12/35	Construction of a mill
Arthur A. Vlier	10,000	Circle Springs Territory, Alaska	7/12/35	Gravel washing equipment
Alaska Exploration & Mining Co., Ltd.	15,000	Valdez Creek Dist., Alaska	7/12/35	Development and mining equipment
Penon de Oro Mines	20,000	Tuolumne Co., Calif.	7/12/35	Development and mining equipment
St. John Gold & Copper Co.	20,000	Yavapai Co., Ariz.	7/12/35	Development and mining equipment
Maricopa Chief Gold Mines	20,000	Maricopa Co., Ariz.	7/12/35	Development and mining equipment
Eugene B. Hart	8,000	Yuma Co., Ariz.	7/12/35	Development and mining equipment
Lucky Five Mining Co.	10,000	Idaho Co., Idaho	7/22/35	Development and mining equipment
Hassayampa Go d Mining Co.	20,000	Yavapai Co., Ariz.	7/22/35	Development and mining equipment
Comanche Mining & Reduction Co.	20,000	Mono Co., Calif.	7/22/35	Development and mining equipment
Scientific Minerals Recovery Corp.	20,000	Amador Co., Calif.	7/22/35	Development and mining equipment
Stanley M. Walker	20,000	Boulder Co., Colo.	7/22/35	Development and mining equipment
Total	$6,605,000			

Idle Mines in Forbestown District, California, to Be Rehabilitated

General Mining Activity Steadily Continues—Some Companies Increase Their Mining Acreage—New Tailings Cyanide Plant to Be Built at Bodie To Treat 500,000 Tons of Tailings

IDAHO MARYLAND Mines Company, operating in Grass Valley, California, is reported to have secured options on a group of mining properties in the Forbestown district, Butte County, and has made arrangements for immediate commencement of rehabilitation and development work. The mines in question were worked about 40 years ago, but many have been idle for years. All work is to be directed by J. E. Ehrhorn, superintendent.

✦With construction of the new surface plant and 100-ton flotation mill rapidly nearing completion at the Spring Hill mine, Grass Valley, Spring Hill Gold Mines, Inc., H. R. Plate, manager, expects to start milling operations and production early in September. The company is also developing the Young America, Mountain Euclid, and Phoenix group of mines, in Sierra County.

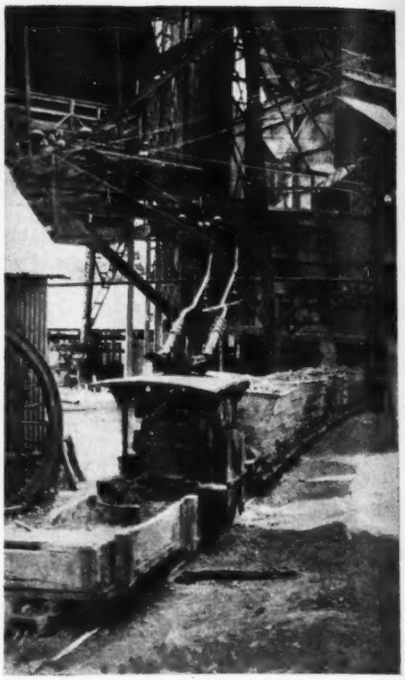
✦According to a report from Jamestown, California Standard Gold Mines Corporation, operating the Erin Go Bragh mine, 2 miles south of Jamestown, plans early erection of a 150-ton flotation mill. The main shaft has recently been deepened to 400 ft. as a preliminary to development of the orebodies found on the 200-ft. level, and a 40-ft. headframe and larger hoisting equipment are to be installed soon. Steve Rowe, superintendent, is in charge of operations.

✦In the Comanche and Loomis placer areas, W. W. Johnson Company, 910 Balfour Building, San Francisco, is erecting a 2½-cu.ft. dredge and a 8½-cu.ft. unit respectively.

✦Following the purchase of the old Madrona dredge at Junction City by the Junction City Mining Company, H. L. Sorenson, president, the new owners have commissioned the Yuba Manufacturing Company to rebuild and provide the 9-cu.ft. unit with a pontoon-type hull. Dredging operations are to start late this fall. A second development in Trinity County is that of the Natomas Company, which is reported to be testing placer ground between Weaverville and Trinity Center.

✦Lava Cap Gold Mining Corporation, operating the Central and Banner mines, near Nevada City, has increased its acreage to 1,300 by the acquisition of the 277-acre McDonald ranch, adjoining the main property to the west. Underground, the Central shaft is to be deepened another 200 ft. to 1,800 ft. after completion of a station on the 1,600-ft. level. The mill is treating close to 200 tons of ore a day.

✦In the Mojave area, the foundations of the new 300-ton cyanide mill have been completed at the Golden Queen mine, and milling machinery is being installed. On Middle Buttes, Kimball & Kempe, operating the Cactus Queen and Blue Eagle mines; Middle Butte Mining, controlled by Walter Trent; and Brite, Burton, and Westfall are making regular shipments of milling and smelting ore.



Home-made electric trolley locomotive at North Star shaft of Empire Star Mines Company, Grass Valley, Calif. Two 25-hp. motors haul twelve 3-ton side-dump cars from crushing plant to mill bin

✦Anglo-American Mining Corporation, Mills Building, San Francisco, has taken over the Standard Consolidated property at Bodie on a 25-year royalty from J. S. Cain and plans early erection of a 250-ton cyanide plant to re-treat about 500,000 tons of tailings and dump ore said to average $3.50 per ton in gold available at the mine.

✦A 50-ton flotation mill is being installed at the property of the Oxford Consolidated Mines Company near Downieville. A crew of 20 men are employed under the direction of J. E. Hinkley, superintendent. Ore reserves are said to amount to 85,000 tons.

✦The Boston mine, near Mokelumne Hill, operated under lease by the Lucky Tiger-Combination Gold Mining Company and employing about 60 men, has been closed down. The action is said to be due to business reasons and not because of an injunction secured by the East Bay Municipal Utility District to prevent dumping of tailings in the Mokelumne River, as reported in the daily press.

✦Kappel Mining Company, developing the old Contention group of claims, between the south and middle forks of the Stanislaus River, near Sonora, is planning new additions to the present surface plant, including a 200-ton mill. Structures and buildings erected recently

Central shaft and headframe of the Lava Cap Gold Mining Corporation near Nevada City, Calif. This shaft will be deepened another 200 ft. to the 1,800-ft. level after the 1,600-ft. station is completed

Smelter Strike at Selby, California

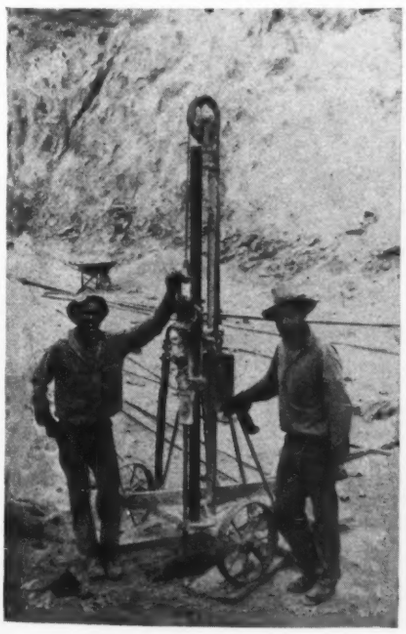
ON Aug. 19 the International Union of Mine, Mill and Smelter Workers walked out on strike at the Selby plant of the American Smelting & Refining Company. The strikers demanded a recognition of the union and a minimum pay of $5 a day instead of $3.

Twenty deputies were dispatched to the scene by county authorities, but no violence took place along the picket lines. Some truck drivers from Nevada mines with trucks loaded with concentrates were stopped by pickets but were permitted to unload upon promise they would stop hauling to the plant.

According to the union heads, the strike is a result of failure to reach an agreement with the employers after the Supreme Court nullified an NRA agreement about to be signed. Longshoremen, in sympathy with the strike, refused to handle the cargo of a Norwegian freighter at the company pier.

include a compressor house, blacksmith shop, assay and mine office, and a bunk house. Mining operations are centered in driving two tunnels, which later will be connected by a raise. Men engaged in the tunnels work on a three-shift basis. About 40 men are employed at the property. R. N. Kappel, Berkeley, is president of the company.

Wagon drill rig used in drilling 20-ft. holes in the Calaveras open cut of the Carson Hill Gold Mining Company, California



Placer Mining in the Murray Gold Belt, Idaho, Follows Testing

Mineral Mountain Mining & Milling Company to Continue Deep Crosscut—Base-metal Mines Show More Activity With Higher Metal Prices—Extensive Development Planned by Yakima Shoshone

MAJOR placer operations in the Murray gold belt are now setting under way in Potosi Gulch, where E. T. Vincent and associates, of Billings, Mont., have taken a bond and lease on a group of claims owned by William Mather. The property is a short distance from Trail Gulch, said to have been the richest gold gulch in the Coeur d'Alenes. Installation of a 20-ton engine and boiler and a dragline capable of handling a large daily tonnage is in progress, and operations will soon begin on virgin ground in which test holes have disclosed profitable amounts of gold.

✦ Good progress is reported in the drift at the Bunker Chance property, in the Wardner district. The crosscut was extended nearly 2,000 ft. to reach the vein, which parallels the Alhambra fault, and the drift has now been extended more than 100 ft. along the footwall side of the vein where the mineralization is said to be increasing.

✦ The board of directors of the Mineral Mountain Mining & Milling Company was recently increased from three to five members. Plans were made for greater underground operations, which were approved by the stockholders. A contract was let to continue the deep crosscut tunnel. Construction of a new compressor house and a blacksmith shop, and other surface improvements, are under way. A compressor will be installed and a power plant completed, thus facilitating the increased scale of operations.

✦ With plans ready for the sinking of a 300-ft. shaft at the property of the General Mines Corporation, adjoining the Page mine of the Federal company, mining interest in that particular section of the Coeur d'Alenes is increasing. The General Mines has done much to prove the geological conditions of that section, and in more than 5,000 ft. of underground work have exposed some veins of gold-silver ore. The corporation owns fourteen claims and 106 acres of patented ground.

✦ Showing a net profit from the second quarter of the current year totaling $265,661.72, compared to $38,981.44 for the corresponding period of 1934, the Hecla mining company forwarded dividend checks to the stockholders in the sum of 10c. per share with a statement of decidedly optimistic tone. In addition to Hecla operations the company is carrying on a systematic development program on the Polaris property, control of which rests with the Hecla company. During the second quarter the company produced 11,504,281 lb. of lead, for which an average price of $4.01 per hundred pounds was received. The zinc shipped totaled 167,746 lb. and sold for an average of $4.24 per hundred. The silver output reached 299,033 oz., and brought 76c. an ounce. The mine output of ore was 61,455 tons during the quarter.

✦ Operations at the property of the Aurora Mining Company on Deer Creek are progressing with good results, according to C. E. Biggs, the president and manager of the corporation. The new machinery, including compressor and power plant, is now in use and the lower tunnel is being advanced. Manager Biggs states the crosscut should encounter the vein at 500 ft. at a depth of about 450 ft. This will be 250 ft. deeper than the upper workings, where values in silver, lead, and gold were obtained. The vein has been traced for 9,000 ft. along well-pronounced outcroppings, and its persistence at depth has been determined in a number of crosscuts driven above the present deep-tunnel level.

✦ Expanding his operations into the Wood River district of Idaho, W. J. Stratton has announced the purchase of the famous old Minnie Moore Mine Company, of which I. N. Rockwell is president. A lease and bond covered the deal, with payments on a royalty basis. The mine has a production record of more than $9,000,000. Efforts during the past few years to locate the faulted orebody have proved unavailing, but it still remains the subject of intense study by some of the most capable geologists of the West, who believe, however, the continuation of the faulted orebody will be found.

✦ Plans for an extensive development program at the property of the Yakima Shoshone Mining Company, locally known as the Nellie, are now under way, according to officers of the company. They have informed the stockholders of intentions to put on a diamond-drill campaign to prove the orebodies at depth. The property is favorably located in the dry ore belt and has disclosed considerable high-grade silver ore in the work thus far accomplished.

Oatman Strike Settled as Miners And Operators Reach Agreement

Strikers Agree to Return to Work on Obtaining Present Wage Scale Up to Jan. 1, 1937—Three Gold Mines Allotted RFC Loans—Tombstone Development Acquires Bunker Hill Property

THE STRIKE of the International Union of Mine, Mill and Smelter Workers called on July 1 in the Oatman district of Arizona was settled on Aug. 9. The strikers agreed to return to work at their old wage scale of $4.50 a day on an agreement that the scale would prevail until Jan. 1, 1937, unless there is a change in the present price of $35 an ounce for gold. Either miners or operators will be at liberty to negotiate for a revision of the present agreement should the price of gold fluctuate. The Tom Reed mine has employed additional men for general repair work and the mill is expected to be in operation about Sept. 1.

✦ Three RFC loans have been granted to Arizona gold mines during the past month. The largest was $750,000 to the Harqua-Hala Gold Mines, whose property is 9 miles south of Salome in Yuma County. Maricopa Chief received $20,000 for development and completion of the mill on the property, 15 miles north of Agua Caliente, in western Maricopa County. A grant of $8,000 was made to R. R. Maier, of Hereford, Cochise County.

✦ In the Groom Creek district, near Prescott, the Nicotine group of claims has been acquired by Walter Black and associates, operators of the Bonnie B. The Home Run mine has been retimbered to the water level, and a pump is being installed.

✦ The Byers prospect, 6 miles north of Buckeye, has been opened to a depth of 150 ft. Ore developed so far is of milling grade.

✦ Bradshaw Mines has been organized to operate the Tillie Starbuck mine, at Prescott, which has been opened by a 2,000-ft. crosscut and drifts on the vein.

✦ Ore from the massive sulphide orebody of the Trinity Gold Mines, Prescott, is being treated in a 25-ton amalgamation-flotation mill.

✦ King Tut Mines plans a 4-mile pipe line to furnish water for working the placer deposits in the Lost Basin district. Seven truckloads of material have been delivered to the company's first site of operations.

✦ Tombstone Development has acquired clear title to the Bunker Hill (Tombstone Consolidated) property from Phelps Dodge. The company is now working the Dry Hill, which was under lease to Three R's. Little Joe shaft is to be deepened to the 400 level.

✦ American Kirkland Gold Mines, Willow Springs, is making plans to install a 15-ton pilot plant.

✦ Shattuck Denn is shipping each month about 3,000 tons of copper ore, carrying gold and silver, to the El Paso smelter. The flotation plant is not in operation.

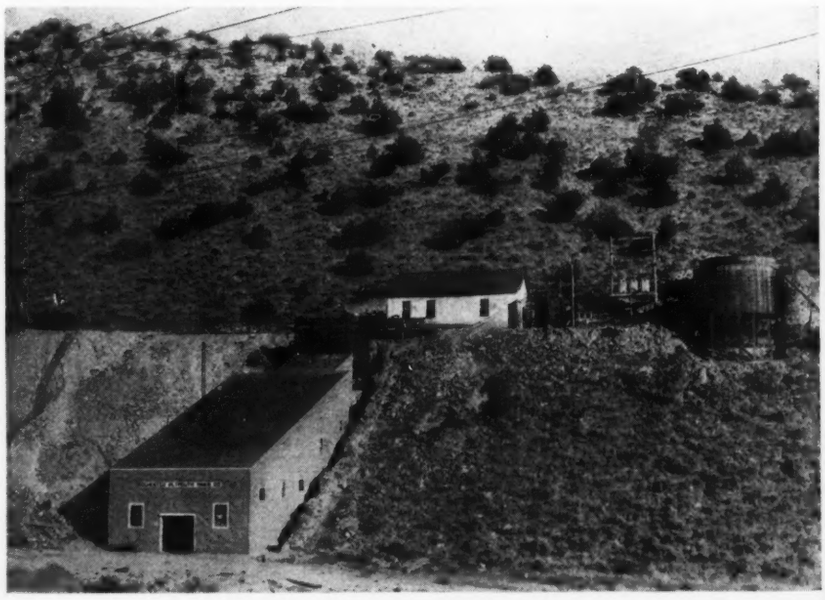
●

Michigan Gold Mines Show Greater Activity

CALUMET & HECLA Consolidated has increased its gold land holdings in the Ishpeming district. Its offer of 10 per cent of the net smelter returns for gold and silver lease rights on 40 acres in Marquette County, adjoining the Ropes gold mine, has been accepted. The land was put up for sale at auction by the Michigan Department of Conservation. It was the first auction of its kind ever held in the State. Calumet & Hecla, whose offer was the only one received, has been carrying on operations at the Ropes mine for several months. In addition to drifting from the bottom level of the Ropes, the company is diamond drilling a vein more than a mile west of the shaft. One hole has been put down and another started. No information is available as to the depth attained or the formation encountered. Drilling later will be done from the drifts which are being driven east and west of the shaft at the 15th or bottom level.

✦ Quincy Mining Company, which has maintained its mine in operative condition the last four years, in expectation that the copper market would improve sufficiently to warrant the resumption of production, has drastically curtailed expenses. A large part of the underground equipment has been removed and placed in storage. Two small gathering pumps in the bottom of the mine have been taken up. It is estimated it will require about two years before the mine waters will accumulate in the bottom and rise to the level of the lower master large pump, when it can then resume pumping and maintain the water at that depth. Recently a bailing skip has been devised that can operate efficiently on the incline skip tracks to remove at any time the water that has accumulated below the big pump, when the smaller pumps can be re-installed. The general underground equipment has been carefully prepared for the idleness so that should business recovery warrant it, the mine and its auxiliaries can be prepared and operations resumed within a short time.

The flotation plant of the Rochester Plymouth Mines Company, at Lower Rochester, Pershing County, Nev., has a capacity of treating about 70 tons ore daily. Equipment in the mill consists of jaw crusher, automatic head sampler, ball mill, classifiers, thickener, and drum filter. Concentrates are shipped by truck to the American Smelting & Refining smelter at Selby, Calif. The mill was designed by Archer Wheeler, of New York, equipped under direction of Frank Mulford, and constructed by E. L. Sweeney, of Denver



NEWS FROM WASHINGTON

By Special Correspondent

CONGRESS HAS GONE HOME. The President is starting his Western tour, variously described as political or vacation, according to the temperament and partisanship of those who comment. But Washington still is the center of much new official development that has great importance for the mining industry.

Legislative enactments now take form in administrative agencies. Labor regulation begins under the new Labor Relations Board. Social security measures are being initiated and a score of other influences on cost and operating method become important. No one can say how important they are.

Even knowing the temperament and the probable trend of thinking of the new officials who administer these laws, one cannot say how fast steps will be taken nor how many of the steps may be offset by further court decisions. Of course, in the last analysis the Supreme Court will be the arbiter of industrial destinies as affected by Federal law and administration.

Laws Enacted

Congress labored valiantly during the longest session of recent years, appropriated nearly ten billion dollars, and passed a long list of new laws fundamentally affecting public welfare and business. But, withal, it was a Congress that accepted direction, not merely leadership, from the White House. The much publicized defeats of the President with respect to the St. Lawrence waterway development and adherence to the World Court pale into insignificance in comparison with reform legislation which was enacted at the President's bidding.

Of all the fundamental bills only one has *direct* importance for the mining industry, as distinct from the many which affect mining as only one of many businesses. This law is the Guffey coal regulation bill. It, though not applicable directly to metals or non-metallic minerals other than coal, is in fact a test case which will determine much of the trend of public participation in the direction of the mineral industries during the next decade.

Most onlookers think that the bill will be held altogether unconstitutional in its scope and purpose when it is up for review in the Supreme Court. If so, then the New Deal must find some different method for handling other mineral-industry problems. If the Court should hold all of the major features of the new coal act valid, which seems highly improbable, then like effort is confidently to be expected next year for other industries, as the New Deal is desirous of securing the same measure and type of control over metals and non-metallics as is first attempted with respect to coal.

None of the other measures of direct importance to the mineral industry were enacted. These, therefore, remain in *status quo* during the interval until Congress convenes in 1936, for the second session of this same Congress. Some of them may, therefore, be enacted next spring. It appears unlikely, however, that any of them, though directly of importance to mining, will have any greater influence than the general legislation on raising taxes, providing for labor regulation, establishing a basis for correction of unemployment, old age, destitution, and other social evils.

The motives of American Federation of Labor in connection with the Guffey bill are the subject of much speculation, highly significant if true. That agency is said to favor the Guffey measure primarily as a means to stimulate recruiting of members, for the Federation is believed to prefer that the bill be in force only for a year or two. Labor leaders probably rightly fear that a successful Federal administration of anything like the Guffey bill would in the long run reduce the attractiveness of Federation membership for the individual. Workers would logically reason that if the Government is going to do all of this labor managing for them, why pay dues to the unions? Other divisions of mining industry affected by organized labor problems can well study these "off-again on-again" trends and appraise the importance of Finnegan within the several fields that may become involved.

Mineral Notes

"MINERAL Trade Notes" is the title of the new monthly mimeographed report of the Bureau of Mines which will includes "notes and comments on the economic and trade aspects of the various metals and industrial minerals (non-metallics) industries." This will be the medium through which the reports from American consular officers will be announced, together with information obtained from any other valuable sources. Those desiring to receive this document may have it on request without charge merely by addressing the Director, Bureau of Mines, Washington, D. C., and indicating the proper mail address at which they wish to receive it.

Under new regulations the Bureau of Mines offers its services for ore testing for the general public. However, when samples are submitted to the Bureau for analysis or examination, those submitting the samples will give to the Bureau exclusive privilege of publishing the results, promising that the reports furnished "will be held strictly confidential until released for publication by the Director of the Bureau." It is anticipated that the only samples which will be accepted for test are those which contribute to the fund of research information desired by the Bureau in its broader studies. By this means the Bureau hopes to avoid undue competition with commercial laboratories and consultants.

Mines Bureau Expansion

Electrometallurgical investigations and combination smelting studies previously described are now definitely under way in the laboratories of the Bureau of Mines (See *E.&M.J.*, June, p. 300, and July, p. 352). Funds available with the beginning of the fiscal year have permitted the naming of a technical staff which is now at work at the Reno station. Dr. J. Koster has been transferred from the College Park station to be metallurgist in charge. Three other chemical and metallurgical investigators are already assisting him on these projects.

New field station construction by the Bureau will be greatly accelerated by allotments granted from the old funds of PWA. The principal new construction will be: A new building for the mining experimental station at College Park, Md., costing $350,000; an extension of the petroleum experimental station at Bartelsville, Okla., with a Government allotment of $250,000 and additional funds donated by the local chamber of commerce; an improvement of roads, grounds, and fences at Bruceton, Pa., explosives testing ground and experimental mine. Senator Thomas, of Utah, favorably reported the bill to construct an $800,000 station at Salt Lake City, but this remains in the calendar of the Senate, unacted on.

Interruption of the helium investigations and the production of helium for

balloon usage has resulted in a change of character of the work at the Amarillo laboratory of the Bureau. The same technical direction will continue, but the projects will relate to fundamental physical and thermal studies on natural-gas flow and pipe-line phenomena of importance to petroleum and natural-gas transmission engineers. The loss of the last Navy dirigible makes discontinuance of helium operations necessary, as the remaining Army and Navy requirements are almost negligible compared with the producing capacity of the Bureau plant.

Manganese Exploration

As a work-relief project, an exploratory development of the manganese deposits near Chamberlain, S. D., has been proposed. One of the most acceptable proposals is that the State should set aside some of this publicly owned territory for pit and trench exploration, with the use of work-relief money for the employment of those entitled to such moneys from the Federal Government. Simultaneously, the proposal contemplates experimental laboratory-scale ore-dressing and metallurgical studies. As soon as the laboratory investigations warrant, a semi-works-scale pilot plant in the field would also be contemplated.

The principles already described in *E.&M.J.* (see May issue, pages 214-15) would apply here. The objective would be the establishment of proved reserves and the development of processes suitable for their utilization. Should such processes prove economic under present business conditions, some commercialization might follow. But at the outset Government planners would be quite content if they could merely establish the scope and best method of opening up these deposits and the prospective cost and best method of operation in event of emergency.

The Chamberlain site is being most seriously considered, as there, according to United States Geological Survey estimates, occurs one of the largest manganiferous deposits known in the world. The economic limitation thus far has, of course, been lack of ore-dressing and metallurgical method suitable for profit-seeking operation.

If this manganese project should be undertaken, it is likely that other similar proposals would find acceptance in Washington, with respect to other regions or for other deficiency minerals and metals. (See *E.&M.J.*, January, 1935, page 11.)

More Talk of NRA

The Administration refuses to consider NRA as dead. The President brought out the Administration pulmotor in the form of a letter to leaders in the House and the Senate just before Congress adjourned. Virtually, his request was for the establishment of a joint Congressional committee which would seek during the recess period to formulate a new law that would re-establish NRA in its former sweep and influence.

Washington was frankly surprised by this action of the President. It sees no possible basis within the past Court decision for making a useful effort in this way with respect to all industry. Furthermore, until the Guffey bill has been tried out in Administration practice and has its court review, it is doubtful whether even the natural resource industries can usefully be subject to further NRA type of control.

The most significant point in this action is the renewed evidence which it gives of the President's determination to pursue his course of reform. He is no longer hampered in his thinking or in his public action by the threat of interfering with recovery. Thus that degree of renewed prosperity which is a comfort to business men is also a basis for political threat of further radical action from the White House.

A substantial number of industrial groups are applying to the Federal Trade Commission for trade practice conferences with a view to establishing rules, both those legally enforceable, Class I, and those which are only morally binding, Class II.

Are Minerals Munitions?

World news may soon become even more important than Washington problems to the mining industry. The seriousness of the Ethiopian controversy cannot be disguised. Intimately interwoven interests of the great powers, including those of the United States, make such controversy of almost as great concern in the United States as in Europe.

Movement of mineral products may be affected in many areas. Not only is military limitation expected; legislative control also may be undertaken by neutral governments. A large crop of bills which sprang up in Washington with this objective commonly referred to "munitions" or "arms traffic" control. Clear definition of these terms is obviously impossible even in the one resolution enacted as an effort to compel an ultra-neutral policy on the part of the United States. That enactment requires the President during the next six months to prevent shipment of munitions to belligerents, thus reserving until the next session of Congress opportunity for direct Congressional control of these matters should the world become involved in hostilities.

The Planning Committee for Mineral Policy, which seemed destined to have a large part in influencing these matters with respect to shortage of strategic metals and minerals, really took no part in Washington affairs during the summer. Differences of opinion within the committee as to its duties and functions occasioned almost complete inactivity. Hence it is not unfair to say that this board is moribund, if not dead. Those who hoped for much in the way of furthering some economic policies for mineral development and control have noted this development with great regret; some still hope that a renewal of activity can be accomplished during the coming fall and winter.

Trade Adviser

Mineral reports from the Consular Service and State Department representatives throughout the world will be substantially improved by the naming of a special technical adviser to work with the foreign service officers. Charles W. Wright, who has been chief engineer of the mining division of the Bureau of Mines, has been detailed to this service and is already abroad undertaking the responsibility of collaboration with the foreign service in planning the trade information to be supplied. For the present Mr. Wright continues as a member of the technical staff in the Economics Branch of the Bureau, but he is also accredited as a member of the Consular Service of the State Department, with station in Rome.

The new cotton policy of the Department of Agriculture appeared at first a firm step toward the restoration of foreign markets for this Southern crop. The original plan of the Administration to reduce the loan value of the crop had the great merit of permitting world prices to stabilize at a lower level than last year and thus give a renewed outlet for American production. Furthermore, the step seemed one toward a new form of export subsidy, a very important indicator of the trend of thinking of the Administration with respect to all exportable surpluses of American produced goods.

Mineral executives may well watch with interest to see whether there is not like opportunity for Federal stimulation of foreign markets for American metals and non-metallic minerals—phosphate rock, for example. If success is achieved for the farmer with respect to any agricultural commodity, then the mineral bloc in Congress can be expected to ask for like favors for the products of the mines of their states. As yet, however, this is merely a short step on a long road of policy making.

Washington wonders what is the real explanation of the sudden outburst from the White House against Soviet propaganda in the United States. Business men are, of course, disturbed by this episode, fearing that it may grow into a business obstacle preventing any benefits being gained from the commercial pact entered into only a few weeks earlier.

Preparations Being Made for Mining Iron-Ore Deposits in Utah

Railroad to Iron Mines Is Completed and General Construction Under Way—Lead and Copper Smelters Expected to Open in October—Sheba Gold to Install New Equipment and Expand Development

PREPARATIONS to mine the Iron Mountain deposits of the Columbia Steel Company have made another step forward with the completion of the new 14-mile branch railroad from Desert Mound to the south side of the mountain, affording a direct connection between the Iron deposit and the Union Pacific branch line at Cedar City, Iron County, Utah. New equipment is being installed by the company preparatory to opening the Black Hawk property. A warehouse, an office building, a laboratory, machine shop, truck garage, compressor house, an employees' garage, electrical sub-station, and facilities for storing gas and oil are being built. Water for mining and culinary purposes has already been developed. A 135-hp. electric shovel with a 2½-yd. capacity for mining and stripping has been installed. Newly mined ore will be run through primary and secondary crushers, conveyed to a screening and loading station, where it will be classified, and then loaded on railroad cars at a three-side tipple. Trackage and loading facilities will have a capacity for loading and moving 50 carloads daily. First ore shipments from the new plant are expected to start to the Ironton, Utah, plant early in November.

✦ Mining and smelting in Utah and the intermountain region promise to take on renewed life in October with the reopening of the American Smelting & Refining lead smelter at Murray, closed since April 1, and the starting up this fall of the copper smelter of the International Smelting Company at Tooele, Utah. For several years, A. S. & R. officials have followed the policy of closing the Murray lead smelter in the spring and reopening in the fall, when the stockpiles have been built up. The usual fall reopening of this plant is foreshadowed by the employment of workmen for rehabilitating the plant.

✦ Similar preliminary work is being done at the copper smelter of the International Smelting Company at Tooele. New 85-lb. rails are being laid for the spur connecting the plant with the Denver and Rio Grande Western branch railroad. A maintenance crew is also at work.

✦ A resumption of copper smelting, providing employment for 250 men, will depend largely on business conditions. A decision on the reopening of the Walker Copper mine, in Plumas County, Calif., is to be made about Oct. 1. If market conditions warrant, the mine will resume production and the mill be put into operation. Concentrates will be shipped to the Tooele plant for smelting. In the interim, the maintenance crew at the Walker has been increased to 100.

✦ At the Mountain City Copper property, also owned by the International Smelting Company, plans are being made to haul 2,000 tons of ore, now stored in stockpiles on the surface, to Elko, 90 miles distant, so that if the smelter does reopen, the ore can be shipped to the Tooele establishment for treatment.

✦ A number of old properties, inactive for some time, have resumed shipments. The Columbus Rexall at Alta, Utah, has shipped several carloads of ore, one lot clearing $4,837.52 for the shippers. The Cardiff mine, in Big Cottonwood, is shipping regularly a silver-lead ore.

✦ Developments include the announcement that Utah Sulphur, Inc., will develop sulphur deposits in Emery County, near Green River, Utah. Roads are being built to the holdings of the company.

✦ Yankee Mine, in American Fork Canyon, is shipping concentrates from its revamped gravity concentrator and also direct shipping ore. Operations have been resumed at the O. K. Silver mine, in the Erickson mining district near Eureka, after many years of idleness. The Charm Gold mine, near Delta, is also being rehabilitated for steady operation.

✦ Leasers operating in the Lewiston Peak property, at Mercur, shipped during July 40 carloads of ore carrying 1 oz. gold to the ton. The discovery was made near the surface in the Mercur bed. The Lewiston Peak company is shipping 150 tons daily, according to George W. Snyder, manager, from the Consolidated Mercur dump and the deposits opened in the new shaft to the Manning mill.

✦ Four feet of high-grade ore has been struck in the 1101 winze of Park City Development Company, according to A. L. Hurley, manager, below the 1,240-ft. level. Deepening of the shaft to develop this important showing at depth has been ordered.

✦ Net profit of Silver King Coalition for the second quarter of the year amounted to $64,433.50 after taxes and depreciation but before depletion. The company shipped during this period 733 tons of lead concentrates and 3,930 tons of zinc concentrates.

✦ A heavily mineralized east-west fissure is being developed in the Ontario quartzite in the Park Standard mine, according to a recent statement by N. A. Dunyon, manager.

✦ Officers of the Sheba Gold Mines, 30 miles south of Gold Hill, in the Deep creek range, are planning to install a 4-ft. ball mill and flotation machinery. The company is now developing gold ore in the Martin level and operating the mill on a limited scale.

Placer gravel is dumped into a truck-mounted trommel screen which rejects oversize of 5 in., and undersize is conveyed to trucks for delivery to the San Juan Metals Corporation's mill, in Colorado

Base-Metal and Gold Mines in Montana Show Steady Improvement

Morning Glory Mines Install a Hadsel Mill—Several Companies Are Enlarging Their Cyanide Plants—Gold Dredging Started in Adler Gulch—Virginia City Will Expand Its Flotation Facilities

RUBY GULCH Mining Company, operating near Zortman, Phillips County, Mont., is preparing to mine low-grade and medium-grade gold ore for a new 300-ton cyanide mill which probably will be erected in the next few months.

✦ Little Ben Mining Company, operating the August group of gold claims near Landusky, Phillips County, is increasing its milling capacity to 150 tons per day. The ore is subjected to coarse crushing and then leached with cyanide solution. Power is supplied by a 110 hp. diesel engine. The company is installing another diesel plant of 225 hp., which may be ready for operation in September, according to P. A. Wickham, Los Angeles mining engineer, in charge of operations.

✦ John L. Templeman, of Butte, recently purchased the Isele silver claim, in the southwest part of Butte. Work was resumed at the property around the middle of August.

✦ Basin Montana Tunnel Company is treating more than 200 tons of silver-gold-lead-zinc ore at its Comet mill, near Basin, Jefferson County. The Comet has been unwatered to the 600 level. Recently some high-grade gold ore was encountered on the 600 level of the company's Grey Eagle mine. Custom ore will soon be milled from the Mount Washington mine, near Wickes.

✦ Morning Glory Mines, near Basin, is installing a Hadsel mill to crush its lower-grade ores, which will be treated by flotation. The company has been a steady shipper of high-grade silver-gold ore.

✦ United Gold Mines of Duluth, headed by Clement Quinn, is enlarging the capacity of its cyanide plant at the Golden Messenger mine, near York, Lewis and Clark County. J. D. Archibald is in charge of operations.

✦ Humphrey Gold Mining Corporation, of Denver, has started operations with its dragline dredge equipment in Alder Gulch, Madison County. The placers are being worked from Nevada City southward, where the company controlls 5 miles of land, part of which was worked by the dredges of the Conrey Company. Several draglines are operated from a central tower over 150 ft. high. The company used twelve carloads of equipment in the installation of its excavating, gold-saving, and stacking machinery and is conducting one of the largest placer operations in the West.

✦ Fairview Mining Company, operating in Wisconsin Gulch, Madison County, has encountered the faulted portion of its vein. According to manager C. M. Roos it is expected that shipments of gold ore will be made soon.

✦ At a special meeting of stockholders, the capital stock of Jardine Mining Company was increased, and strong Eastern interests have entered the company, according to Harry C. Bacorn, president and general manager. The company is now producing at a profit, and, with the new financing, will enlarge its output of gold, silver, tungsten, and arsenic materially. Seventy-five men are employed at Jardine, Park County, and the company has its own hydro-electric plant.

✦ Virginia City Gold Mining Company, operating the Prospect group, in Madison County, is enlarging its flotation mill to treat 70 tons per day and is erecting a cyanide plant of 150 tons' capacity to treat present flotation tailings and an accumulated tailings dump. R. E. Sawyer, of Butte, is in charge of operations.

✦ Pohlman interests and Charles Wethered, of Spokane, have taken over the Big Seven mine, in the Neihart district, Cascade County, and are now operating actively.

✦ Basin Goldfields, Ltd., 1½ miles northwest of Basin, is steadily developing orebodies of milling and shipping grade ore.

Program of Mining Congress Meeting Will Promote Live Topics for Members

New Markets and Uses for Base Metals and Minerals, Labor Relations and Social Legislation, National Silver Policy, and the Government's Policy Toward Western Mining States Are Current-Interest Topics to Be Considered at Meeting in Chicago Sept. 23 to 27

THE apparent upward activity of the non-ferrous mining industry and the social and economic trends during the past year will afford members attending the Western Division of the American Mining Congress at the Palmer House, in Chicago, from Sept. 23 to 27, the opportunity for some lively and interesting discussions. At the noon luncheon on Sept. 23, with James F. Callbreath presiding, the delegates will meet Howard I. Young, president; E. A. Hamilton, chairman Western Division; W. B. Daly, chairman program committee, and Julian D. Conover, secretary.

Speakers for the afternoon session and their subjects are: Dr. C. K. Leith, vice-chairman, Planning Committee for Mineral Policy, National Resources Board, "Planning for Production of Mineral Products"; John Wellington Finch, "The Government's Policy Toward Western Mineral States"; Harold I. Ickes, Secretary of the Interior, who may possibly speak on "Our Public Land Policy."

On Sept. 24 Robert E. Tally will speak on "Workable Stabilization of Mineral Production." He will be followed by W. Mont Ferry, who may discuss "Non-Ferrous Industries and National Prosperity." Key Pittman will take for his subject, "Effect of Silver Purchase Policy on World Currencies and Trade." A luncheon sponsored by the Western Mine Operators Associations will follow the morning speakers. The fourth session will be devoted to discussions of developments of detachable bits, and D. Harrington, of the Bureau of Mines, will speak on "Developing Safety Methods in Metal Mining." Discussion giving description of effective safety practices in the non-ferrous mines will follow.

On Sept. 25, the morning session will be devoted to methods of efficient underground haulage, dust control, improved underground lighting, direct reduction of iron ore to steel, and developments in geophysical prospecting. D. E. Cummings, field director of Saranac Laboratory for the Study of Tuberculosis, will speak on "Prevention of Silicosis Through Modern Dust Control." The topic of discussion at the luncheon will be "Industrial Relations in the Tri-State District." M. D. Harbaugh, secretary of the Tri-State Zinc and Lead Ore Producers' Association, will be the principal speaker. Following this discussion the remainder of the day will be given to general subjects

dealing with industry, government and major factors involved in the rehabilitation of the mining industry. C. F. Kelly, president of Anaconda Copper, is the suggested speaker for the topic "Industry's Responsibility to Its Government, Its Employees, Its Stockholders." C. R. Gray, president of the Union Pacific System, has been asked to deliver an address entitled "The Challenge to Industry." Other suggested speakers on that day will be Stanly A. Easton, president of Bunker Hill & Sullivan, and H. DeWitt Smith, of Newmont Mining Corporation, the latter speaking on "Modern Industrial Relations in the Metal Mining Industries."

The seventh session on the morning of Sept. 26 will treat the subject of taxation. A. W. Dickinson, American Mining Congress, will speak on "The Revenue Act of 1935." The covering of a broader field of taxation will be taken up by H. B. Fernald, of Loomis, Suffern & Fernald, who will speak on "International Tax Problems." The subject of additional taxes to meet present-day social legislative requirements will be discussed by a speaker to be announced at the meeting. E. C. Alvord, attorney, will enlighten the members on "Treasury Treatment of Depreciation Allowances." Carl Zapffe, manager of iron-ore properties of the Northern Pacific Railway, will tell about taxation in the iron country. The luncheon on this day will be sponsored by the Lake Superior Iron Ore Association and the subject for discussion will be announced later.

The eighth session will be spent on the Wagner labor disputes law, social legislation, and 30 hour bills. The suggested speaker is Harper Sibley, president of the United States Chamber of Commerce. Discussion on the important subjects mentioned in the foregoing will be made by the leaders in all branches of the mineral industry. The matter of labor union responsibilities in the industry will also be given consideration.

On Sept. 27 members will hear about flotation of gold and oxidized gold, and gold occurrences in Arizona. Edward L. Sweeney, consulting engineer, of Denver, will speak on "Recent Trends in Design and Construction of Gold and Silver Mill." The subject of handling heavy media in mineral separation and the advantages of modern explosives will also be discussed at this session. The topic at the luncheon will be "Co-operative Action in Behalf of Mining." A conference of presidents of coal and metal-mining associations will be held to concur on coordinated action. Trips will be arranged by the local trips committee.

An exposition of mining equipment and supplies will be held in connection with the meeting, with leading manufacturers of mining equipment participating.

Mexican Ministry of National Economy Creates Service Bureau

Arbitration Between Workmen and Operators Prevents a Strike in the Santa Eulalia and Fresnillo Mining Districts—Organized Mexican and American Miners Seek Mutual-Aid Agreements

NEW EXPLOITATION WORK and the resumption of operations on properties that have been idle for a long time are features of current activities in the Mexican mining industry.

✦ The Ministry of National Economy has made a special department of the Natural Resource Exploration Bureau, whose field work will cover the states of Guanajuato, Zacatecas, and Michoacan. This department will render free advice to the mining industry and to small-scale miners. It will also give assistance in exploring mineral lands to cooperative societies of miners.

✦ The American Smelting & Refining Company has brought Dr. W. W. Gay, noted American specialist in lung diseases, to Mexico for the purpose of investigating alleged cases of silicosis among some of its underground employees. It is the company's desire to render specialized service for the study of this disease, in addition to that offered by the physicians of the federal labor department.

✦ The National Railways of Mexico announces that the construction of the branch railroad between Michos and Suchil, Durango, serving a large mining region, will be resumed in October, at the end of the rainy season.

✦ Kildun Mining has obtained from a Mexico City federal district court an injunction against the enforcement of the ruling of the federal board of conciliation and arbitration that the strike now on among its employees is legal and justified.

✦ The agricultural ministry has approved plans submitted by Mexican Candelaria Company for building a dam on the Las Truchas River, Sinaloa, to store 4,000,000 cubic meters of water to assure the steady operation of electric machinery in the mining company's metal-treatment plants. The dam will cost 210,000 pesos (approximately $60,000, U. S.).

✦ Large ore shipments from mines in central Mexico have obliged the smelter at Fresnillo, Zacatecas, to go on a 24-hour daily operation basis, according to the ministry of national economy.

✦ Arrangements for a fraternal and mutual aid agreement are being made by the Union of Mine, Metallurgical and Smelter Workers of the Mexican Republic with organized American miners and mill and smelter employees. The union claims a membership of 50,000.

✦ Mines of the Piedra Bola Mining, in Jalisco, which were closed for several weeks by a strike, are now functioning normally.

✦ Work has been intensified on the Esperanza mineral lot, Rosales municipality, Chihuahua.

✦ The San Francisco Mines of Mexico, Ltd., treated during the month of July, 32,790 metric tons sulphides and 7,720 metric tons oxides. Lead concentrates produced totaled 5,152 metric tons, and zinc concentrates, 2,400 metric tons.

✦ Cia. Minera Plomosa, S. A., has commenced exploitation work on the Clarines tract, Santa Barbara municipality, Chihuahua state. Cia. Minas de Oro del Pacifico, S. A., has begun operations on the El Molino property, Mazatlan municipality, Sinaloa state.

✦ A syndicate organized by Watson and White, of New York City, as acquired, by stock purchase, a majority interest in the old Los Cuates mine, now officially known as the San Jose de Ledesma, Badiraguato municipality, Sinaloa state. It is proposed to get the mine ready for operations at an early date. Work was suspended in this mine at the outbreak of the revolution in 1911 and it has been idle for almost 24 years. The mine was first opened in 1885 and it was formerly a producer of gold and silver ore.

✦ Movement of ore and minerals from mines and smelters in central Mexico is now normal after some disruption of rail service due to washouts and landslides caused by prolonged and torrential rains this summer.

✦ Strike movements for higher pay that involved two major mining companies were averted by the intervention of the federal labor department. A strike of 4,000 employees of the Zacatecas state properties of Fresnillo Mining was called off a few hours after it had started, as the labor department induced the disgruntled workmen to accept arbitration. A like movement was abandoned before it had started by workers of the Santa Eulalia, Chihuahua state, unit of the Potosi Mining Company. These workers also accepted arbitration.

Gold Exports from Canada Second to Dominion's Entire Commodity Trade

Canadian Gold Mines Contribute Strength to Country's Trade and Finance—Chromium Mining & Smelting Corporation Starts Operation of Reduction Plant—Dome Putting Down New Shaft

THE RELATIVE importance to Canada of the gold-mining industry is now fairly obvious to the people of the Dominion. Its vital relation to commercial credits abroad and to the federal government's obligations abroad was realized by government officials some years ago, and the Prime Minister has acknowledge publicly the important part gold from the mines has played in Dominion finances. Though gold constituted last year 53 per cent in value of the metal output, 37 per cent of the total mineral output, and one-fifth of the value of the field crops, it had a disproportionate influence on external trade and finance. Discussing the present active and widespread development of gold throughout the Dominion, the report says: "The economic importance of primary gold production to the Dominion may be better appreciated when it is stated that the net value of gold exports was surpassed only by the favorable balance of exports in the entire commodity trade of the Dominion, the favorable balance of $145,000,000 in the entire commodity trade being raised to $239,200,000 when the balance of gold exports is included. Again, the net value of gold exports equaled 41 per cent of the net interest and dividend payments to foreign holders of Canadian securities, whether governmental, municipal, or corporation, and were $19,200,000 in excess of the Dominion's requirements to meet its capital payments on maturing bonds." It is also interesting to note that the Canadian gold production per capita has increased within the last decade from $3.86 in 1926 to $9.45 in 1934.

The report repeats the suggestion, originating recently in Great Britain, that representatives of the gold industry in the various countries be invited to consult with the next World Economic and Monetary Conference, in order to make available information and estimates on gold production, present and future, which only they can provide.

BRITISH COLUMBIA

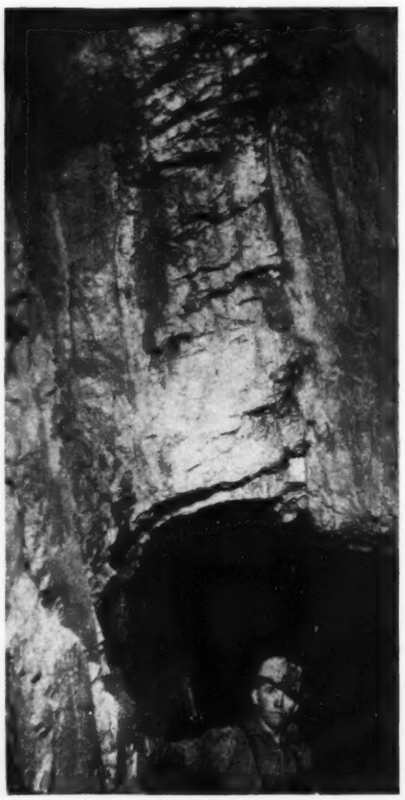
✦ In the Bridge River area, at the Bralorne, 3,844 oz. of gold, valued at $134,540, was produced in July from 11,929 tons of ore, including about 1,000 tons trucked from Bradian since the merger on July 11. This compared with 3,037 oz. gold recovered in June from 10,920 tons of ore. The 5,000-ft. crosscut that is being driven from Bralorne 8th level to connect with Bradian No. 2 shaft intersected a mineralized zone 8 ft. wide when about 500 ft. from the main adit.

✦ The power house, machine plant, and two smaller buildings of the Consolidated Gold Alluvials, at Wingdam, which were destroyed by fire recently, are being reconstructed and the machinery is to be replaced.

✦ A decision will soon be reached concerning the erection of a large mill at the Big Missouri by Consolidated M. & S., and in the event of this being undertaken, the Provincial Government has intimated that it will construct a new road into the property. Consolidated meanwhile has optioned a group of claims adjoining the property to the north. At Alice Arm, a 30-ton mill is under construction on the Esperanza, where a 4-ft. vein carrying a satisfactory grade of ore has been exposed for a length of 300 ft. on the surface and opened by tunnel workings.

✦ The Gold Mountain mine, in the Hedley camp, Similkameen district, has been optioned by the Consolidated company, which will spend $50,000 on development in return for a 60 per cent interest. The Nickel Plate is now in full operation; over 200 tons are being milled daily, and 160 men are employed. At the Hedley Mascot, adjoining Nickel Plate to the south, satisfactory progress is being made in the advancement of the tunnel; and construction of the 150-ton mill will commence as soon as the road is completed.

Ore from this vein in the Kootenay Belle Gold Mines, in British Columbia, is sent to a 60-ton mill where gold is recovered by methods employing amalgamation and flotation



ONTARIO

✦ Starting with the lowest-grade gold mine in Canada, the District of Patricia has gone to the other extreme in Central Patricia and the neighboring Pickle Crow, whose ore runs about an ounce. The Pickle Crow shaft is now at 650 ft. and the 625 level has been established. Drifting on the older levels down to 375 ft. continues to show new ore, and recently a new parallel vein was uncovered on surface. There is thus good reason for expecting that the present 100-ton mill will soon be doubled in capacity. At present the grade of ore being milled, largely from surface dumps, is averaging about 2/3 oz.

✦ Hollinger's subsidiary at Hislop is to be further tested by a 100-ton mill, the erection of which has been commenced. The deposit has been diamond-drilled, and this and the mine openings to 150-ft. depth show large gold bearing deposits but a very erratic distribution of the gold.

✦ Kenora Prospectors & Mines, Ltd., are installing a 50-ton mill at the company's mine on Cedar Island, in Shoal Lake, Lake of the Woods district. Shoots of ore of moderate size and about one ounce grade have been developed to 500-ft. depth.

✦ The new internal shaft of Dome Mines, starting on the 2,000-ft. level at a distance of 5,000 ft. east of the main shaft, is designed to open for production the area where about 350,000 tons of ore has been outlined, and to develop this area both laterally and to a depth of 4,000 ft. or more. Though the engineers of the staff of Dome are thoroughly accustomed to erratic deposits in the old mine area that has now kept the mill going for a quarter of a century, the nature of the new deposits to the east is still more difficult to determine.

✦ Wendigo Mines, whose property in the Lake of the Woods district is de-

veloped to 500 ft. with a substantial tonnage of $10 to $12 ore, is preparing to install a small mill. H. G. Young is managing director.

✦ On Aug. 23 the reduction plant at Sault Ste. Marie of Chromium Mining & Smelting Corporation of Canada was put in operation, using concentrate from the company's mine at Obonga Lake, west of Lake Nipigon. The reduction plant was acquired from Superior Alloys, Ltd., which erected it for the production of ferro-silicon and other ferro-alloys. The chromium project has been brought to fruition by A. R. Globe.

QUEBEC

✦ Perron Gold, in the Pascalis-Louvicourt area, is constructing a 100-ton amalgamation and cyanide mill, following the development of a good volume of ore of about half-ounce grade in several veins down to the 325-ft. level.

✦ The Shawkey Gold Mines, a few miles south of the Siscoe, has developed about eighteen months' supply of ore of about half-ounce grade in levels down to 450 ft. and is installing a 100-ton mill arranged for expansion.

✦ With its initial 250-ton unit operating smoothly, the mill at the Lamaque mine of Teck-Hughes is being doubled in capacity, as originally planned.

✦ Greene-Stabell is sinking a new shaft to explore a mineralized zone north of the mine. Production for 1934 was $246,023, giving an operating profit of $44,957.

MANITOBA

✦ The Central Manitoba gold field continues to expand steadily. With 50,000 tons of 0.40-oz. ore now available, Gunnar Gold is making arrangements for a 150-ton mill. At Forty-Four, opened by a long drive eastward under Rice Lake from the 600-ft. level of San Antonio, ore of about half-ounce grade is now being opened by drifting.

✦ Attention is now centered on the Gods Lake mine, farthest north mine of eastern Canada, whose 150-ton mill will go into operation during September, coincident with the completion of the 2,000-hp. power plant at Kanuchuan Falls, 40 miles to the east.

NORTHWEST TERRITORIES

✦ The results of surface prospecting and drilling on the Beaverlodge Point gold property of Consolidated Mining & Smelting Company have induced the company to ship in a mining plant for a campaign of underground development. Athona Mines is also preparing to sink a prospect shaft. As excellent facilities are available for transportation by water from the railway at McMurray, development costs will be moderate.

Yellowdine to Erect a Cyanide Plant in Western Australia

Gold Recovery to Be Made by Straight Cyanidation in an Installation of 5,000 Tons' Monthly Capacity—Shafts in the Tavua Field of Fiji Islands Down 50 Feet—Geologists Active in Fiji

YELLOWDINE Gold Development, Ltd., the London company engaged in opening up the recently found gold field at Yellowdine, near Southern Cross, W. A., has reported that to 100 ft. depth 130,000 tons assaying 30 dwt. is indicated. The lineal extension has been proved for over 3,000 ft. That the depth of the several orebodies will be limited to 100 ft. is not likely, and a large addition to the tonnage mentioned may be expected. A treatment plant with a capacity of 5,000 tons of ore monthly is to be erected and is expected to recover 90 per cent of the gold by straight cyanidation. Working costs are estimated conservatively at 30s. per ton, indicating a profit of more than £600,000 annually. The field was discovered by two prospectors last November.

✦ On the Fiji field there is feverish activity. The two important development companies—Koroere and Loloma—are shaft sinking and driving adits; the last named has proved some very rich telluride ore over a length of 500 ft. At present the shafts are down to only 50 ft. The lodes occur in light-colored andesite, and doubt has been expressed as to whether they will continue at depth. Even if they do not, a large quantity of gold will be taken from the Tavua field.

✦ The Broken Hill South Company's new lead-zinc flotation section, which has a capacity of 8,000 tons monthly, has just been placed in commission. The cells are of steel, built to a design developed by the mine staff. Power consumption has been reduced by 37 per cent, compared with the old plant, to 17 kw.-hr. per ton of crude ore treated.

✦ Adelong Gold Dredging, which operates a small dredge, capacity 15,000 cu.yd. weekly, at Bright, has paid its first dividend after treating 1,045,000 cu.yd. for 3,029 oz., equivalent to 1.39 grains of fine gold per cubic yard. Heavy indebtedness has been liquidated from profits and the company is now likely to have a profitable future. Good progress is being made with the erection of the dredge of Cocks Eldorado at Eldorado. This will have a capacity of 200,000 cu.yd. monthly and will be the largest ever operated in Australia. In the Avoca district boring of the deep alluvial is in progress, and several large deep dredging plants will probably be erected in due course. The future of the gold-mining industry in Victoria is largely dependent on dredging and deep lead mining.

✦ Victorian Gold Alluvials and Mines Development, Ltd., has been formed, with a nominal capital of £1,000,000 in 5s. shares, to develop deep lead mines in Victoria. The Langi Logan field, at Ararat, will be one of the centers of the company's activities.

✦ Wiluna Gold Mines, Ltd., is treating regularly more than 45,000 tons monthly at a profit of approximately 20s. per ton. Mining costs, including development, are 21s. per ton. The company has erected a small pilot plant for the treatment of ore from the Moonlight property, at North Wiluna. This ore contains appreciable antimony, but a satisfactory method of treatment has been evolved. The Moonlight property, which is owned by Goldfields Australian Development, Ltd., is to be worked with power and air supplied by Wiluna Gold Mines, Ltd. Wiluna's west lode has been proved to 1,390 ft. by a winze from the level above. The ore assays 9 dwt. This is the lowest point penetrated on the field and is a favorable indication of permanence of the orebodies at depth.

✦ Edie Creek Gold Mining Company, operating at Edie Creek, New Guinea, has proved 67,000 tons of ore and is enlarging its treatment plant.

✦ Mount Coolon Gold Mines, Queensland, has suspended operations indefinitely because of water shortage. The company has sufficient ore for about six months' operations only.

✦ The practice of employing geologists to control development activities is extending. Bendigo Mines, Ltd.; Mount Isa Mines, Ltd.; Mount Lyell Mining & Railway Company; Wiluna, Lake View & Star; and the Broken Hill companies have one or more geologists attached to the staff. Improved development work has undoubtedly resulted. In Fiji, on the new gold field at Tavua, several geologists are employed plotting the numerous exposures on behalf of developmental companies.

✦ The Australian gold yield for the half year ended June 30, 1935, has been estimated at 383,300 fine ounces, or 46,000 oz. less than for the corresponding period of last year. The decline is due to the strike in Western Australia, where the output is 55,000 oz. less.

South African Mining Companies Wish for Lighter Tax Burden

Rand High-Grade Gold Mines Less Profitable to Work Due to Taxation—Kimingini Gold Mines, in Kenya, First to Reach Production Stage in East Africa—Zinc Corporation, Ltd., May Maintain Production for 25-Years

REPORTS from Johannesburg are to the effect that efforts are being made to find a way to ease the tax burden of the Rand gold-mining companies, but that politics is found to be an obstruction at every turn. Those engaged in agricultural, pastoral, and other industries apparently feel that the mines should carry the whole tax burden, and the politicians have shaped their policies accordingly. At the same time, a general election is looming, and the Rand vote is big enough to elect or defeat any party. Their difficulties are winning for the South African politicians the sympathy of the whole world, and diverting attention from the fact that taxation is making it less profitable to mine high-grade than low-grade ore.

✦ Working profits of the South African gold mines in June, according to the Transvaal Chamber of Mines, were £2,687,564 (gold taken at 141s.), against £2,778,968 in May when gold was taken at 142s. The higher price for gold has not brought the rapid increase of production that was expected, as is indicated by the profit having been £2,607,331 in June, 1934, with gold taken at 137s.

✦ W. Gemmill, general manager of Transvaal Chamber of Mines, says the experimental employment of 2,000 natives from north of 22 degrees latitude has been so successful that the Witwatersrand is planning to employ several thousands of Northern Nyasaland natives. Recruiting from Northern and Southern Rhodesia is also being considered.

✦ Acting-Governor Wade of Kenya Colony, starting the machinery when operations began at the Kimingini Gold Mining Company's property recently, referred to it as the first East African mine to reach the producing stage. He said relations with the natives were now of the friendliest character, adding: "I do not suppose that anywhere in the world has a gold field been established with so little friction and with so much good will." The local represenative of the company said expenditure had amounted to £180,000. The mill has a capacity of 100 tons daily. It is being tuned up on the lowest-grade ore. The first run reported was 1,056 tons of 7.12 dwt. ore. As the tailings averaged 1.23 dwt., a recovery of 83 per cent was indicated.

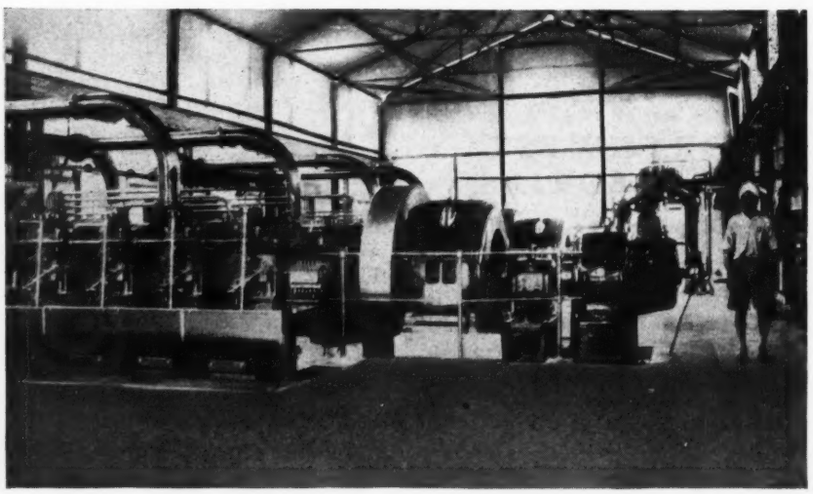
The first gold mine in Kenya Colony, East Africa, to reach the production stage is that of Kimingini Gold Mining Company. The 100-ton mill will treat gold ore from the Kimingini Reef. Power plant is at lower left of mill structure

✦ The £3,000,000 which the Soviet Government has agreed to pay Lena Goldfields over a period of twenty years, in consideration of having confiscated the company's properties, is being fought over in the courts by fifteen lawyers representing the company and the Czechoslovakian creditors. How the fund shall be divided is the question at stake, if any remains after the litigation ends.

✦ Rhokana Corporation, Ltd., reports that for the year ended June 30 smelter production was 69,301 long tons of blister copper; 53,509 tons was shipped as blister, and 15,792 tons turned over to the company's electrolytic plant at the property to be refined. The management estimates the profit for the year, after interest, depreciation, and development expenditures, but subject to taxation, to have been £325,000.

✦ At the meeting of Zinc Corporation, Ltd., Sir Robert Horne, the chairman, said: "I believe we are entitled to expect, on the geological evidence before us, a life of not less than 25 years at the present rate of production." He said the amount expended on new plant last year was £38,209, and that £40,000 had been appropriated for similar expenditure this year.

Interior of power plant which supplies current for the 100-ton mill and compressed air for mining purposes in the Kimingini Gold Mines



PERSONAL ITEMS

A. W. Allen recently left San Francisco for South America.

H. Foster Bain has returned to New York from a trip around the world.

Carl R. Davis is president-elect of the Institution of Mining and Metallurgy.

B. A. Holm has retired as Mining Commissioner of Bulawayo. He is succeeded by **S. B. Norris.**

Bennett R. Bates is in Kenya Colony on work for East African Goldfields, Ltd.

Vincent Ryan, manager of the Shawkey gold mine, in northern Quebec, is preparing to install a 100-ton mill.

Russel Kohlen has been placed in charge of the Silverman mill, at Tombstone, Ariz., succeeding **A. M. Bell.**

Richard Hamilton has been elected president of the Chamber of Mines of Western Australia for the 35th year.

J. C. Brumblay, field representative for International Smelting, has completed mining examinations in southern Nevada.

H. G. Iverson has accepted a position as ore-testing engineer and mill shift boss with the Itogon Mining Company, Baguio, P. I.

R. Charlick has been transferred from the staff of the Beattie mine, Quebec, to manager of Guysboro Mines, at Goldenville, N. S.

Walter A. Rukeyser has been appointed president of Minefinders Limited, Toronto, of which **J. C. Rogers** is now vice-president.

C. B. Jeppe, of Johannesburg, will visit the United States prior to assuming his duties as a professor at the University of the Witwatersrand.

A. S. Shakhmouradov, head of Glavzvetmet (Non-ferrous Mining Trust) U.S. S.R., is in the United States visiting Western mining properties.

John Littlepage, formerly consulting mining engineer to the Gold Mining Trust of U.S.S.R., is now acting as mine superintendent for the Trust.

L. E. Djingheuzian, until recently assistant to the general manager of Lake Shore mine, is now metallurgist of Siscoe Gold Mines, operating in the Province of Quebec.

R. J. Ennis, general manager of McIntyre-Porcupine, in northern Ontario, has been elected president of the Ontario Mining Association for the current year.

Dr. B. H. Moore, principal of the Kalgoorlie School of Mines, in Western Australia, left early in June on a visit to England and the United States.

Corey C. Brayton, sales engineer, American Manganese Steel Company, San Francisco, has sailed for Alaska, where he will inspect dredging operations.

P. H. Reagan, superintendent of the Chalchihuites units for the Fresnillo company at Zacatecas, Mexico, has resigned and is now located in Mexico City.

E. S. Jeanes has been appointed superintendent of the Toughnut property of U. S. S. & R. at Tombstone, Ariz. **R. T. Walker** has been transferred to other properties.

W. R. Wade, an associate of John Hays Hammond, and president of Park City Consolidated Mines Company, has gone West to visit mining properties in which he is interested.

W. B. Gohring, onetime secretary of the Arizona Chapter of the American Mining Congress, has been appointed to represent the Mine Loan Division of the RFC in Arizona.

O. C. Ralston has been appointed supervising chemical engineer of the non-metallic minerals experiment station of the United States Bureau of Mines at New Brunswick, N. J.

R. J. Farquharson is developing the Gilmour gold mine, in southeastern Ontario, the original gold district of the province, where several old properties have recently been reopened.

Dr. George R. Mansfield and **G. B. Richards,** of the United States Geological Survey, recently visited Logan, Utah, while en route to make a survey of the Bear Lake country in Manitoba.

R. R. Rose, formerly general superintendent of Cariboo Gold Quartz Mining Company, Ltd., at Barkerville, B. C., has been appointed managing-director, and is in full charge of operations.

John Van Nostrand Dorr recently married Mrs. Virginia Nell Koons at Nefane, Vt. They sailed on Aug. 31 for Europe and South Africa and expect to remain abroad for two or three months.

Harold Taylour, formerly Warden and Chief Inspector of Mines, New Guinea, has been appointed general manager of Enterprise of New Guinea, N. L., which is working sluicing claims in New Guinea.

H. J. Urquhart has resigned the chairmanship of a number of the De Bernales operating companies, and also his post as chief technical adviser of that organization, on account of ill health.

William R. Marshall, formerly associated with W. F. Snyder & Son as metallurgist in the operation of Manning Gold Mines, is now mill foreman for the Elkoro Mines Operating Company at Jarbridge, Nev.

Russell P. Lucke, general superintendent, South American Development Company, Portovelo, Province El Oro, Equador, arrived in San Francisco from Guayaquil for an extended vacation in the United States.

Major B. Lightfoot, Director of the Geological Survey of Southern Rhodesia, will visit the United States under the auspices of the Carnegie Corporation, to investigate the organization of geological departments.

General Eulalio Guiterrez, a wealthy mine operator of the Concepcion del Oro region, Zacatecas, and former President of Mexico, has established a large fruit and vegetable packing house at Ramos Arizpe, Coahuila.

George Haun has accepted a contract from the Miner-Slide Mines, Inc., at Gold Hill, Colorado, to sink a 300-ft. shaft, to be completed in 90 days or less. Work is proceeding 24 hours a day, and the crew is advancing 7 ft. per day.

Arnold W. Harris, formerly mill superintendent of Wiluna Gold Mines, Ltd., in Western Australia, has been appointed consulting mechanical engineer to that company and to Lake View & Star, Ltd., in the Kalgoorlie district.

H. F. Berry has transferred from the Deloro Smelting & Refining Company to the O'Brien Gold Mine, where he is installing a roasting and cyaniding plant to treat the concentrate which is high in arsenic. **Harry E. Sparks** is manager.

John Wightman, who is in charge of the operations of Consolidated Mining & Smelting Company in Nova Scotia, is conducting an extensive underground exploration of the Cariboo district and is diamond-drilling in the Dufferin district.

J. R. Sweet has resigned from his position as chief engineer with the Warren Foundry & Pipe Corporation, Mount Hope mine, Wharton, N. J., and is now serving as assistant mine superintendent for Climax Molybdenum at Climax, Colo.

William B. Daly, general manager of mines of Anaconda Copper at Butte and head of the program committee of the September meeting of the American Mining Congress in Chicago, is recovering after a painful accident on the golf links.

F. W. Leighton has been appointed mines superintendent of Edjudina Consolidated, Ltd., and left London on July 18 for the company's properties in Western Australia. British American Mines are the general managers for the company.

W. O. Wood, mining engineer, formerly for a number of years in Arizona and New Mexico, has been appointed general manager of the Appollonia Goldfields, Ltd., operating mines at Nkawkaw and Mankwadi, Gold Coast Colony, West Africa.

R. T. Mishler, during a number of years mine manager for Lucky Tiger-Combination Gold Mining and lately in charge of the Buckskin National mine, in northern Nevada, has resigned to accept the management of mines at Fresnillo, Mexico.

Frank C. Mulford, Western head of the metallurgical staff of Archer E. Wheeler, of New York, is directing operation of the flotation mills of Como Mines, 8 miles south of Dayton, Nev., and Rochester Plymouth, some 200 miles apart by highway.

Marion Mercer, on leave of absence from the Museum of Science and Industry, Chicago, will examine nonmetallic properties in eastern Kentucky and gold and silver properties in old Mexico near Guadalahara, in the interests of Eastern capital.

Allen W. Jeckell has been appointed manager for Power Gold Mining Company, at Anori, Province of Antioquia, Colombia, to direct the hydraulic placer operations at the company's Vallecitos property. The head office of the company is in Toronto.

Alexander L. Feild, consulting engineer for the Rustless Iron Corporation of America and president of the Alloy Research Corporation, has been appointed professor of metallurgy at the Carnegie Institute of Technology. He will assume his new duties in September.

Michael Curley, of Ajo, Ariz., general superintendent of New Cornelia Copper Company, is spending a month in the Lake Superior region. He left the region twenty years ago. His return visit was made the occasion of a celebration at Coleraine, by 50 of his former associates.

Edward C. Miller has resigned his position as development engineer with the electrothermic zinc smelter of the St. Joseph Lead Company at Josephtown, Pa., to accept an instructorship on the faculty of the School of Chemical Engineering of Purdue University, Lafayette, Ind.

J. A. Verdussen, manager of the Chituru Works (leaching plant) of the Union Minière du Haut-Katanga, left Katanga in August, returning to Belgium via Johannesburg and the East Coast of Africa. His new address is: 10, Avenue des Ormeaux, Uccle, Brussels, Belgium.

Eldon L. Brown, who made an enviable record in the rapid development of Sherritt-Gordon in an isolated locality, has repeated the performance at the Gods Lake gold mine, in the far north of Manitoba, 130 miles from the Hudson Bay railway.

G. A. Gow, metallurgist, formerly associated with interests operating in Taiyudo, Korea, recently visited several metallurgical plants in the United States and Canada. Mr. Gow is now with the Bibiani 1927, Ltd., in the Gold Coast Colony, West Africa.

H. M. Clackworthy, Government Mining Engineer, has announced the establishment of a Government Assay Office at Bulawayo, Southern Rhodesia. It will be conducted in conjunction with the School of Mines to be started at the Technical School there.

Lawrence B. Wright has moved his offices to 321 Federal Building, Toronto, and has also established connections in New York at No. 1440, 17 Battery Place. He will continue his association with Alison & Company, of Canada, Ltd., and is also supervising geological work in the Little Long Lac area.

L. W. Buchanan, formerly mill superintendent at the Gold River Mining Company, has joined the engineering staff of Marsman & Company in the Philippines. He is now on the Gold Creek property, supervising the handling of the Gold Creek ore by the Antamok Goldfields Mining Company.

Jesse J. MacDonald has been appointed mill superintendent for the Sierra Consolidated Mining Company, which is operating the old Silverado mine, near Sweetwater, Nev., though the mine is just inside the California State line. The company has a 100-ton mill and a complete countercurrent decantation cyanide plant. It is installing flotation, also, to treat gold-silver ores.

Dr. Joseph P. Connolly has been appointed by the Regents of Education of South Dakota as president of the South Dakota State School of Mines to succeed the late **Dr. C. C. O'Harra.** Dr. Connolly has been professor of mineralogy, petrography, and economic geology at the School of Mines since 1919, and vice-president since 1926. The appointment as president is effective Aug. 1.

Dr. H. T. James, formerly superintendent of the Pioneer Gold Mines of British Columbia, Ltd., has been appointed managing-director in succession to the late David Sloan. Dr. James is a graduate of the University of British Columbia, and also holds degrees from Wisconsin and Harvard Universities. For two years he was government resident engineer in northwestern British Columbia and previously was attached to the Geological Survey of Canada.

James L. Hall, of the geological staff at Balatoc, has become resident engineer for Benguet Consolidated at the chromite properties of Consolidated mines, Inc., in Zambales province, P. I. **D. G. Headley,** assayer at Benguet, has gone to the Zambales property to handle the assaying for the new mine. **Harold Cogswell,** formerly resident engineer, has returned to Benguet Consolidated because of ill health. **R. L. Loofbourow,** mine shift boss at Balatoc, has been promoted to the position of assistant mine engineer and geologist.

Dr. James H. Hance, recently appointed dean of the school of mines at the University of Alaska in Fairbanks, left Salt Lake City Aug. 20 to assume his duties at the far northern school. Dr. Hance took his doctor's degree in geology at the University of Chicago. Teaching at the University of Illinois, the Texas Agricultural and Mechanics College, and the University of Oregon, where he was dean of the school of mines, followed. During recent months, he has been in charge of preliminary engineering work for the reclamation service on the proposed Deer Creek reservoir project, near Provo, Utah.

William Wearne, of Duluth, Minn., general superintendent of iron-ore properties of Inland Steel Company, retired voluntarily on Sept. 1, to take up his residence in San Diego, Calif. Mr. Wearne, who was a graduate of the Houghton School of Mines, came to Inland in 1906 as the superintendent of the Laura Mine, when that property was taken over by the company, and since that date all of the developments of the company with respect to iron mining have taken place under his supervision. He developed the company's mines on the Cuyuna range and later supervised the taking over of the Morris and Greenwood mines on the Marquette range. No announcement has been made as to his successor.

Albert Sauveur, Sc.D., Gordon McKay professor of metallurgy and metallography, Harvard University; **George S. Rice,** E.M., Chief Mining Engineer, United States Bureau of Mines; **Millard King Shaler,** consulting engineer, Brussels, Belgium; **Arthur D. Storke,** managing director of Roan Antelope Mines, Ltd., Selection Trust Building, Mason's Ave., Coleman St., London, E. C. 2, England; and **Bailey Willis,** E.M., C.E., emeritus professor of geology in Stanford University, Stanford University, California, have been designated as official representatives of the United States to attend the Seventh International Congress of Mines, Metallurgy, and Applied Geology, to be held at Paris from Oct. 20 to 26 of this year. The invitation to assign representatives was transmitted by the French Ambassador at Washington. **Dr. Sauveur** will act as chairman of the delegation.

P. Fitzgerald, general manager of Youanmi Gold Mines, Ltd., returned at the end of July from a business visit to Great Britain.

J. C. Kinnear, general manager of the McGill, Nevada, properties of The Nevada Consolidated Copper Company, is making an extended trip to Central and South America.

S. A. Lewisohn, vice-president of the Miami Copper Company, recently attended the conference of the International Labor Organization at Geneva, as an American delegate.

Dr. Loftus Hills, consulting geologist, is in charge of the development operations of a number of companies operating on the Tavua gold field, Fiji Islands.

Guy Finlayson will soon depart from England to assume the post of chief metallurgist to Ashanti-Adowsena (Banket) Goldfields, Gold Coast Colony, West Africa.

H. A. Buehler and **A. B. Parsons,** president and secretary, respectively, of the A.I.M.E., recently visited the Lake Superior iron-ore region. They were entertained at Crosby, Hibbing, and Duluth, Minn.

OBITUARY

Bruce Kennedy, well known in mining circles in Mashonaland, South Africa, died recently at Filabusi, aged 52.

Richard Zinn, of Ironwood, Mich., manager of Michigan mine for Pickands Mather, died on July 22 from a heart attack.

Thomas G. Morris, War veteran and well-known Park City, Utah, mining man, died recently at Salt Lake City; aged 51.

John F. W. Doelpke, operator of the Midget and Bonanza King mines, in the Cripple Creek district of Colorado, died at Colorado Springs on Aug. 27 at the age of 75.

W. Kennon Jewett, well-known Western mining man and philanthropist, and operator of the London Gold mine, in Colorado, died at Santa Barbara, Calif., on Aug. 27, at the age of 78.

George Straight, who was engaged in mining enterprises in the Barberton district of South Africa, died recently at Barberton. He had formerly been engaged in mining work in Australia.

Thomas Powell, 38, assistant superintendent of the Garfield, Utah, plant of the American Smelting & Refining Company, was fatally burned on July 24 when a wall collapsed while he was cooling slag with a hose.

Thomas Ernest Childers died in Prescott, Ariz., on Aug. 1. Before his illness he was foreman at the Golden Turkey. Earlier he had been with Southwestern Mines, Meteor Crater, and Hidden Treasure.

E. H. A. Cohen, pioneer South African mining engineer, died recently in Johannesburg, in his 75th year. Prior to his going to South Africa Mr. Cohen had practiced his profession in the United States, Canada, and the West Indies.

B. W. Traylor, prominent crushing and mining engineer, and district manager of the Southern sales office of the Traylor Engineering & Manufacturing Company, Allentown, Pa., died of a heart attack, at Louisville, Ky., on Aug. 14th, aged 64.

George C. Klug, general manager in Australia for Bewick Moreing & Company, died suddenly in London, aged 60. He was a director of Zinc Corporation, Ltd., Electrolytic Zinc Company of Australasia, Ltd., Gold Mines of Australia, Ltd., and many others.

Donald Sloane, manager of Pioneer Gold Mines (British Columbia), who was reported in the August issue of *E.&M.J.* as having been injured in the plane crash that resulted in the death of **Dr. R. W. Brock,** died on Aug. 5 from the effects of the accident. **Mrs. Brock,** reported also as injured, died soon after the crash.

E. P. Cowles, manager of East Geduld mines, in the Transvaal, and also responsible for the operation of Grootvlei, died recently while making a tour of the Geduld underground workings. Mr. Cowles was 46 years old. He was born in Canada and was a graduate of McGill University.

Jose Sordo Mijares, a member of the board of directors of the Negociacion Minera Santa Maria de la Paz y Anexas, S. A., which operates mines at Matehuala, San Luis Potosi, and a director of the Banco Nacional de Mexico, S. A., died at his home in Mexico City on Aug. 9, aged 72 years. He was born in Spain and came to Mexico at an early age.

George W. Lambourne, a prominent Utah mining man, died in Los Angeles recently, at the age of 68. Mr. Lambourne had devoted the last 40 years of his life to the development of the mineral resources of Utah. At the time of his death he was president and general manager of the Park Utah Consolidated Mines Company and the Park City Utah Mines Company.

Lieutenant-Colonel Harry Hogg Yuill, formerly of the British Royal Engineers, and known internationally in mining engineering circles, died in Vancouver, B. C., on Sept. 3. Colonel Yuill won marked distinction in the World War and was awarded several British decorations for valor in action as well as the Croix de Guerre of France and the Montenegrin gold medal for bravery.

Leslie Barry, Ernest Hutchinson, and **Thomas Burton Caygill,** all prominently identified with the mining industry of Southern Rhodesia, died recently within a few days, according to a report from Bulawayo. **Cecil Carbutt,** eldest son of the Chief Native Commissioner of Southern Rhodesia; **Harry Long,** pioneer mining man of South Africa; **Baden Powell Thornthwaite,** prominent in the development of the Mazoe district; and **J. Badham,** an official of Wemmer and Village Deep before his retirement, also died recently in that country.

Henry Briggs, Hood professor of mining at Edinborough University since 1924, and one of the most distinguished mining engineers of Great Britain, died on Aug. 26 at the age of 52. Professor Briggs made many contributions to mine rescue work and increased safety in mining, and to mine surveying. He conducted many mineral surveys for the British Government and during the War was technical adviser to the War Office. He was the author of many books on mining subjects. Among the societies of which he was a distinguished member were the Royal School of Mines, the Royal Geological Society, the Royal Society of Edinborough, Royal Scottish Society of Arts, the Order of the British Empire, and the Order of St. John of Jerusalem.

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James Malcolm MacLaren

An Appreciation by
M. W. von Bernewitz

James Malcolm MacLaren's early demise mentioned in *E. & M. J.* for April, 1935, calls for additional notice. That obituary lists nine countries in which he made geological studies, but he had been in all of Australia and New Zealand, all of the Americas except Ecuador, all of Africa except the West Coast, all of Europe except Denmark, and all of Asia except Indo-China. Up to the end of 1929 he had traveled one million miles in his investigations. This was mentioned in *E. & M. J.* for November 23, 1929. As far as I know, MacLaren specialized in gold deposits, and his book, "Gold" (*The Mining Journal,* London, 1908), was a standard reference. "Jimmy," the name by which he was known by his close friends, was the son of an engineer and was born at Thames, New Zealand, now a worked-out gold field, where he and I attended the high school and the school of mines, at the latter under James Park, whose books on assaying, cyaniding, geology, and hydraulics are well known. At first, MacLaren was working in a bank and took night courses and later day courses in geology and mining. Then he studied in the School of Mines in Otago University, Dunedin, graduating from there. Thence his travels commenced. In 1900 he was assistant government geologist in Queensland. Later, he made London and Cornwall (near Redruth) his headquarters, his widow and family living in the latter country. A few years ago a young son passed on. Apparently, MacLaren wrote little for publication and bothered little with engineer societies. His life's work on gold occurrences has been worth while. *Ko te mea tenei e whakapouritia nuitia ai ahau,* as the Maoris say.

NEW BOOKS

How to Market New Industrial Products

CHECK SHEET: INTRODUCTION OF NEW INDUSTRIAL PRODUCTS. *By O. C. Holleran, Marketing Research and Service Division, Bureau of Foreign and Domestic Commerce, Washington, D. C. Pp. 23, charts 2. Price 5c.*

This is a study designed to help manufacturers avoid pitfalls in the course of introducing a new industrial product. The marketing field is strewn with failures, particularly of industrial products, due primarily to the fact that manufacturers overlooked important marketing factors in their sales efforts, or in the design, production, and servicing of the product. Since few companies are organized to give adequate consideration to many of these problems, this pamphlet and the accompanying charts will be a welcome aid to successful marketing.

Seventeen major problems which the manufacturer must face in introducing a new industrial product are discussed in detail. These are then arranged in convenient chart form so that the manufacturer may check his consideration of each question involved. Chart I deals with nine phases of marketing, such as extent of the market, buying habits, competition, and channels of distribution. Chart II covers eight problems relating to such matters as design and engineering, production, materials, service, and capital investment. The entire study is an admirable contribution to the elimination of waste and loss in the manufacture and distribution of the products of industry.

ARCHITECTURAL, STRUCTURAL, AND MONUMENTAL STONES. *By George A. Thiel and Carl E. Dutton. Bulletin 25. University of Minnesota Press. Minneapolis. Pp. 160. Price $2.50.*

The purpose of this book is to acquaint those interested with the merits of the various stones quarried and fabricated in Minnesota. A dozen plates show the coloring and appearance of some of these stones, when polished, rubbed, or otherwise prepared. In addition, some 78 other halftones and line drawings are included.

THE MINING MANUAL FOR 1935. *Published by the Statistical Research Bureau, 108 West Sixth St., Los Angeles, Calif. Pp. 320. Price $2 postpaid.*

This is a new manual and the only publication of its kind issued in the United States. It represents an effort to provide reliable and authoritative information on the principal mining companies of the United States and possessions, together with a few of the larger mining enterprises in Canada, Mexico, and South America. The current volume contains information on about 500 companies. In addition there is a glossary of mining terms, statistics of metal production, a map of the mining districts of the Western States, and summaries of 1934 transactions in mining securities on the leading exchanges.

TECHNOLOGIE MINIÈRE. *By Michel Castelain and Eugène Stalinsky. Dunod, Paris. Pp. 541. Price 95. Fr.*

Improved mining methods and rapid modernization of machinery, particularly an extended use of electrical and pneumatic equipment, have resulted in greatly increased efficiency in French mines since the War. This progress, which is particularly noticeable during the last five years, is well portrayed in the present volume. The subject matter is presented under the following main headings: Study of deposits; blasting; mining methods; iron ore mining; underground mining; ventilation; pumping; compressed air; underground haulage; hoisting; mining laws. A glossary of special French mining terms has been appended.

ESTADISTICA MINERA Y METALURGICA DE ESPANA, *1933. Published by the Consejo de Mineria, Ministerio de Industria y Comercio, Madrid, Spain. Pp. 691.*

Part I of this book, comprising 185 pages, consists in the main of statistics of production, classified by products and provinces, and including data on number of workmen employed, tonnage, and value of output, installed horsepower, consumption of explosives, and similar information. Part 2 occupies the rest of the book and consists of reviews of mining and metallurgical situation in each province during the year of record.

PUBLICATIONS RECEIVED

Canada's Eastern Arctic. Its History, Resources, Population, and Administration (including a chapter on the geology of the region and two pages on mining regulations). Department of the interior, Ottawa, Canada. Pp. 166.

Annuaire Statistique Hongrois. 1933. (Including metal and mineral statistics for Hungary.) Published by l'Office Central Hongrois de Statistique, Budapest. Price, 6 pengös (1 pengö = 30c.). Pp. 431.

Gypsum in the Union of South Africa. By B. Wasserstein. Bulletin 3, Geological Series, Department of Mines, Pretoria. Pp. 35. Price 1s.

South Australia Mining Review No. 60. For the half year ended June 30, 1934. Harrison Weir, Government Printer, Adelaide. Pp. 72.

The following papers have been issued by the U. S. Bureau of Mines, Washington, D. C. "I.C." means Information Circular, and "R.I." Report of Investigations:

National Safety Competition of 1934. By W. W. Adams and T. D. Lawrence. R.I. 3277. Pp. 20.

Detector for Quantitative Estimation of Low Concentrations of Hydrogen Sulphide. By J. B. Littlefield, W. P. Yant, and L. B. Berger. R.I. 3276. Pp. 13.

Studies on the Recovery of Gold and Silver. By seven investigators. R.I. 3275, Part II. Pp. 65.

Prospecting for Lode Gold and Locating Claims on the Public Domain. By E. D. Gardner. I.C. 6843. Pp. 20.

List of Devices for Respiratory Protection Approved by U. S. Bureau of Mines. By W. P. Yant. I.C. 6845. Pp. 6.

Placer Mining Methods of E. T. Fisher Co., Atlantic City, Wyo. By C. L. Ross and E. D. Gardner. I.C. 6846. Pp. 11.

Effects of Breathing Dusts With Special Reference to Silicosis, Review of Literature On. Parts IIA, Chapter 4, "Prevention of Dust Diseases." By D. Harrington and Sara J. Davenport. Information Circular 6840 of U. S. Bureau of Mines, Washington, D. C. Pp. 69-107.

Gold and Silver Custom Plants. By E. D. Gardner. Information Circular 6842, U. S. Bureau of Mines, Washington, D. C. Pp. 4.

The Fertilizer Industries. By Paul M. Tyler. Information Circular 6843, U. S. Bureau of Mines, Washington, D. C. Pp. 41.

The following papers have been received from the American Institute of Mining and Metallurgical Engineers, New York:

Methods and Costs of Handling and Breaking Ore and Rock in Bulldozing Chambers. By C. W. Wright. T.P. 636. Pp. 19.

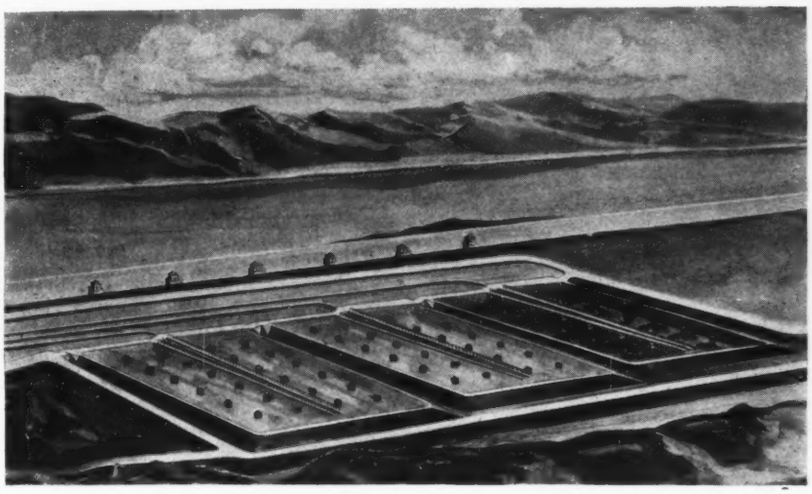
Control of Dust in Mines (three papers). T.P. 637. Pp. 23.

Good Practice in Combating Dust Hazards Associated With Mining Operations. By D. E. Cummings. T.P. 638. Pp. 12.

Factors Related to Man-hour Studies in Metal-mining Operations. By G. B. Holderer. T.P. 635. Pp. 11.

EQUIPMENT NEWS

Cleaning the Colorado River



Artist's sketch of continuous desilting plant for clarification of Colorado River at Imperial Dam, near Yuma, Ariz.

• To clarify the Colorado River before it enters the All American canal to irrigate 1,000,000 acres of land in California, the Bureau of Reclamation will construct near Yuma, Ariz., a desilting plant consisting of 72 125-ft. Dorr thickeners. The machines will be similar to those widely used in cyaniding and ore dressing.

The desilting plant will be the largest ever constructed for that purpose, and is the result of six years of research and development by the engineering staffs of the Reclamation Bureau and The Dorr Company. It is designed to handle nearly eight billion gallons of water in 24 hours, removing from 50,000 to 70,000 tons of silt a day, depending upon the flow of the river and the turbidity of the water, which may carry almost one-half of 1 per cent of silt. Only the coarse silt—plus 270 mesh—will be removed and returned to the river below the canal intake.

As illustrated herewith, the plant will comprise six settling basins, 769 ft. long, 269 ft. wide and 14 ft. deep, arranged in pairs. Each pair will be fed by an influent channel receiving water from the head works of the Imperial diversion dam.

In the course of investigation and research on the project, 35 tons of Colorado River silt was shipped to The Dorr Company's research laboratories at Westport, Conn., where for several months 3,600,000 gal. of water and 24 tons of silt were treated daily under conditions that are to be expected in practice.

Heavy-Duty Rock Bit Grinder For Detachable Bits

• A rock-bit grinder for heavy duty is announced by the Mine & Smelter Supply Company, of Denver, Colo. The machine is a self-contained unit with two grinding wheels 22 in. apart for sharpening any size or type of detachable bit. One wheel is V-faced for grinding the cutting edges of the bit, whereas the other wheel is bevel faced for the grinding gage. This affords a two-man operation, one for grinding and the other for gaging. The machine is equipped for a standard V-belt motor drive, and in one model the water tank is located within the base, together with a centrifugal pump which supplies water to the grinding surfaces. Another pan returns the waters to three settling compartments in the tank. The machine is equipped with a gaging dial which indicates the correct diameter after the first bit is ground and the dial is set. This feature is said to add to production speed.

In addition to the model in 3 types mentioned in the foregoing, the company reports a bench type with an angle-iron base, with or without drainage pan or pump. The bench type weighs about 800 lb. and the three remaining types each weigh 1,000 lb., 1,300 lb., and 1,650 lb.

Homes Built of Copper Resist Deterioration

• To encourage the building of moderately priced copper houses, a subsidiary of Kennecott Copper Corporation, known as Copper Houses, Inc., announces the completion of its first copper house at Bethesda, a suburb of Washington, D. C. The construction principals used in the copper house, built with a framework of structural steel, can be applied to almost any type of design and can be built by common building methods and regular building mechanics. Compared with the same design in brick or wood, the construction is said to be more favorable to copper. The outside walls, roof, and roofing accessories, in addition to plumbing and heating lines, hardware, and many other things within the house, are of copper or copper alloys, which protect against deterioration.

The outside walls consist of heavy copper plates backed by half-inch com-

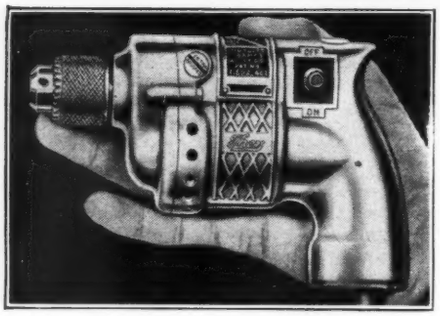
Copper sheets are used for walls for the modern home

position board, which adds stability to the sheets and minimizes metallic noises when the plates are struck. The sheets of copper are held together by specially designed bronze holding strips, which provide for horizontal and vertical expansion and make the building weather and insect proof. The roof is covered with regular 16-oz. sheet copper over a wood deck, and heat and cold insulation is provided for by a 4-in. thickness of spun glass inside the walls and roof. Inside walls of the house are plastered on metal lath and the space between is also filled with spun glass. Though the total thickness of the wall is only about 6 in., the insulation is said to be so efficient that it is equivalent to approximately 8 ft. of solid masonry in keeping out heat or cold.

The present designs planned range in cost upward from approximately $4,500.

Small Portable Electric Drill For One-Hand Operation

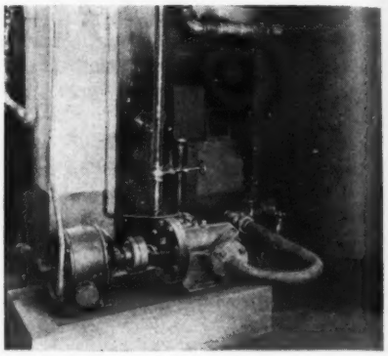
• The Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, announces the smallest, lightest-weight portable electric drill weighing 2½ lb., which is half the size and weight of other drills of the same power. It fits easily in one hand and is said to drill through steel ¼ in. thick in five seconds. High-grade ball bearing and accurately machined heat-treated helical gears are said to reduce the noise and vibration to a minimum and to maintain high motor efficiency. The Thor patented ventilating system provides effective cooling of the motor, which is said to increase the power by enabling the motor to pull, without overheating, a sustained load close to maximum capacity. The U-14, with a capacity of ¼ in. drilling, free speed of 2,500 r.p.m., has an over-all length of 6¾ in.



A Rotary Displacement Pump

• A new type of rotary displacement pump is announced by the De Laval Steam Turbine Company, Trenton, N. J. This pump is said to embody a number of radically new features, particularly the ability to run at speeds heretofore considered impracticable for displacement pumps. Power is applied to a central or power rotor, which meshes with one or more sealing rotors of such form that they are propelled largely by fluid pressure, with a minimum of mechanical contact. This action is said to result from the ingenious shape of the threads, those of the power rotor being convex, whereas those of the idler rotor are concave. This patented tooth form is said to accomplish sealing so effectively that numerous turns of the thread around the rotor, as found in common screw pumps, are not required to keep slippage to a small value. There are only three moving parts, and except for small thrust buttons to maintain the relative axial positions of the rotors, no separate bearings are used, nor are pilot gears required. Only one stuffing box is necessary.

Working parts of the pump, consisting of the impeller and sealing members in relative operating position



Impeller pump in lubricating system

These pumps are known as the "De Laval-Imo," and are available in capacities ranging from ½ to 700 g.p.m. and for pressures up to 500 lb. per square inch.

Lift Truck Operation Made Easy

• A multiple-stroke lift truck, with which a load can be lifted with eight short or four full strokes, all of them easy by virtue of the slide lift used, has been developed by Barrett-Cravens Company, 3255 West 30th St., Chicago. Each stroke of the handle requires the same lifting effort. The handle is automatically disengaged upon release of the holding latch and cannot fly back when releasing the load. Use of ball bearings assures easy rolling and makes it possible to take care of side thrust on the wheel hubs when turning corners. The truck has a lift of 3 in.

Over hazardous mountain roads skillful drivers of these "Caterpillar" tractors haul 2-ton loads of mining supplies in special wagons to the Azurite Mining Company in Mazama, Wash.

Smooth Metallic Screens of Any Metal, Mesh, Size, or Thickness

• A new improved system said to be, basically, a "controlled ionic migration," used in the making of smooth surface screens of copper, nickel, brass, or any other metal that can be deposited electrolytically, is announced by the Electrolytic Products Corporation, of 250 West 39th St., New York City. These screens are now reported being produced for industrial purposes and can be made in any desired mesh. Screens as fine as 400 holes per linear inch—that is, 160,000 holes per square inch—have been made and finer mesh can be produced if desired. Being formed electrolytically, these screens have a smooth surface and are reported to have been used successfully in photoengraving work and in certain high-grade telephone transmitters and broadcast transmitters, because they possess desirable acoustic properties. Problems involving sifting

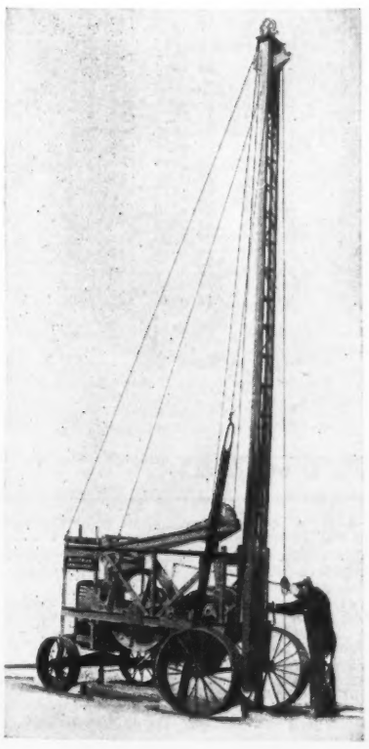
or straining are said to be simplified by the use of this smooth screen, as no wedge-like cross wires are found which create collections of solids. A 120-mesh woven wire-cloth screen would have an opening of approximately 0.0045 in., whereas a 120-mesh uniform smooth surface screen made by this new process is reported to be made with a hole in excess of 0.006 in., or a smaller size to 0.001 in. or even less if specified. The control of the size of the holes will vary somewhat with the mesh, but, generally speaking, the hole can be made as small as desired irrespective of the mesh. For any given mesh the maximum size hole is approximately 75 per cent of the center distance of the holes, as, for instance, in the 120-mesh screen the center distance of the hole is 0.0083 in. and the maximum holes that can be economically produced is 75 per cent of this figure, or 0.0062 in.

The cost of these smooth metallic screens is said to compare favorably in most cases with woven-wire cloth screen.

A New Churn Type Drill

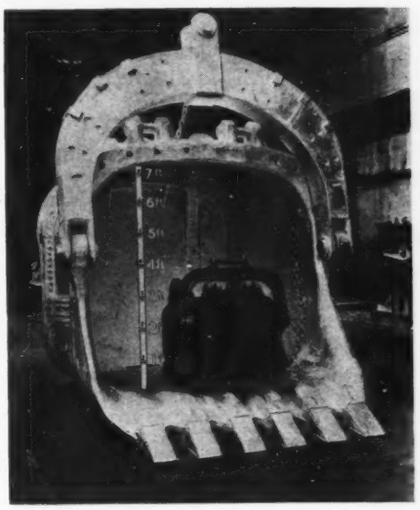
• The Bucyrus-Erie Company, South Milwaukee, Wis., has announced a new Bucyrus-Armstrong 21-W churn-type drill which will drill holes to 300 ft. in depth and to 6 in. in diameter. This rig is said to be sturdy and of all steel construction, and capable of handling a thousand pounds of tools. Power is furnished by a heavy-duty four-cylinder industrial gasoline engine. It is said that clay and shale formation and some small rock projects can be drilled for blasting at a low cost. It may be mounted on a drill boat by removing the wheel mounting and setting machine on two skids. Choice of mounting is available on a truck, as a two-wheel or four-wheel trailer; or for team or tractor haul.

A rig which drills holes 300 ft. in depth and to 6 in. in diameter



Composite Type Part Aluminum Dipper

• The American Manganese Steel Company has announced the production of composite-type power-shovel dippers of unusually light weight which are made of aluminum alloy and high-tensile rolled steel, for parts not subjected to the heaviest abrasion. It is said this new type dipper in the larger sizes can weigh less than half of the solid all-cast type, thereby allowing a great increase in shovel capacity without corresponding increase in power used. This composite



This 15-cu.yd. dipper made of aluminum alloy and high-tensile rolled steel shows the progress made in dipper design and capacity when compared with the dwarfed, 1-cu.yd. all-cast type

dipper weighs 32,940 lb., compared with 74,000 lb., the weight of a 15-yd. manganese-steel dipper. In this unit the front plates are said to be of high-tensile rolled steel welded with spacers to form a double wall between top and bottom castings. The back plate is of rolled aluminum alloy, and the back braces connecting top and bottom castings are cast aluminum alloy.

The makers do not claim that these composite dippers will stand the same abuse that an all-manganese steel dipper of the same capacity can undergo, but for medium work where a plate of cast-steel dipper affords sufficient structural strength, they believe this type of dipper will show greater economy by reason of the impact and wear resistance of the exposed manganese steel part. This dipper was shipped to a coal company to be used in stripping.

Trough Conveyor Self-Aligned By Positive Means

• Self-aligning, anti-friction idlers for troughed conveyor belts have been announced by Link-Belt Company, Chicago. They are known by the name of "Positive." Each has anti-friction actuating rolls near the outside of the carrier rolls, at right angles to the latter, which swivel the idler enough to train the belt when its edge is so misaligned as to touch either actuating roll. Both actuating rolls and pivot have anti-friction bearings.

Correction—In the May issue of *E.&M.J.*, on page 260, under heading "New Diesel Locomotive for Mines Built in United States," there appears an erroneous impression in the sentence "that the United States Bureau of Mines, in its Information Circular 6732, has approved diesel locomotives for underground use." The Information Circular states: "It appears reasonably safe to employ diesel locomotives which use a heavy non-volatile fuel oil." The Bureau of Mines has advised that this does not mean it has given "approval" to specific diesel locomotives for mine haulage.

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BULLETINS

Steel Forgings. Hadfields, Ltd., East Hecla and Hecla Works, Sheffield, England. Bulletin No. 379. Heavy steel forgings. Illustrated. Pp. 11.

Coupling Catalog. The New Franke Coupling. John Waldron Corporation, New Brunswick, N. J. Tables of coupling sizes and coupling service factors.

Pumps. Pomona Pump Co., 206 East Commercial St., Pomona, Calif. Bulletin 16-B, describing and illustrating pumps in various uses for 15 to 7,000 g.p.m. Pp. 39.

Vibrating Screens. Allis-Chalmers, Milwaukee, Wis. Bulletin 1474A, Suspension of Vibrating Screens by Cables and Springs. Pp. 7.

Belt Conveyors. Jeffrey Manufacturing Co., Columbus, Ohio. Catalog No. 610. Belt conveyors for various industrial purposes, illustrations and capacity tables. Pp. 112.

Couplings for Water Lines. S. R. Dresser Mfg. Co., Bradford, Pa. Booklet, Form 355. Pp. 16.

Hitchings, Couplers, and Wheels. National Malleable & Steel Castings Co., Cleveland, Ohio. Circular No. 87. Mine car wheels and couplers. Pp. 7.

Wire Cloth. Audubon Wire Cloth Corp., Philadelphia, Pa. Catalog No. 40. Specifications, tables, list prices, and uses of wire cloth. Pp. 56.

Bearings. S.K.F. Industries, Inc., Front St. and Erie Ave., Philadelphia, Pa. Catalog describing ball- and roller-bearing transmission appliances. Pp. 32.

Rolled Steel. Illinois and Carnegie Steel Companies, Chicago and Pittsburgh. Technical booklet on application of flame cutting and welding rolled steel. Pp. 16.

Gearmotors. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Leaflet No. 2203. August, 1935. Various types and applications of gearmotors. Pp. 4.

Rotary Positive Blowers. Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 21-B-17. Blowers for pressure or vacuum service. Pp. 4.

Portable Compressor. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W-850-B-48A. Model 105 gasoline-driven compressor, 105 cu. ft. per minute actual air. Pp. 4.

Portable Compressor. Worthington Pump & Machinery Corp., Harrison, N. J., Bulletin W-850-B-49. Model 160 gasoline-driven compressor, 160 cu.ft. per minute actual air. Pp. 4.

Portable Compressor. Worthington Pump & Machinery Corp., Harrison, N. J., Bulletin W-850-B-50. Model 210 gasoline-driven compressor, 210 cu.ft. per minute actual air. Pp. 4.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

WITH general industrial operations pointing upward, contrary to the usual summer trend, and production of major non-ferrous metals maintained at about the same level as earlier in the year, consumers showed even more confidence in the outlook for business than in the previous month and purchased substantial tonnages. The knowledge that producers are determined to secure an adequate return for the "under-priced" metals also served to stimulate buying interest.

Prices strengthened, with the exception of those of tin and silver, and our weighted index number for August moved up to 74.00, against 73.53 (revised) in July.

The feature in the market was the heavy trading in copper. Sales for the month of August totaled close to 124,500 tons, against 73,500 tons in July. Most of the demand for copper was for November shipment metal, though the near positions were not neglected. The strength in the price-structure of domestic copper resulted in the purchase on Aug. 19 of 69,000 tons, virtually all of which sold on the basis of 8c., Valley. On the following day the price became firmly established at 8½c. Domestic deliveries of copper during July, the latest month for which statistics have been issued, amounted to 45,000 tons, a gain of 9,000 tons over the figures for June. August shipments promise to be large. The advance in the domestic price greatly strengthened the European market.

Effective Aug. 27, the British customs duties on unwrought non-Empire lead and zinc were revised to 7½ shillings and 12½ shillings, respectively, or 10 per cent ad valorem, whichever is less. The revised duties substitute for a flat 10 per cent duty, with no obligation on either purchaser or seller to buy or supply Empire metal on ordinary brands. Pressure of foreign lead and zinc on the London market is expected to diminish.

Purchases of silver in the world market by the United States Treasury were very extensive during August. Offerings originating in India and China depressed prices and caused the world market to decline more than 2c. per ounce. On Aug. 14, the Treasury purchased about 25,500,000 oz. of silver in the world market, the largest single day's operations since the silver program started.

Early in the month the International Tin Committee recommended that production of tin be increased from 50 per cent to 65 per cent of standard tonnages, retroactive to July 1 and effective for a period of three months. This action eased prices moderately.

United States Market

1935 Aug.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	7.775	7.500	52.625	4.15	4.00	4.40
2	7.775	7.550	52.550	4.20	4.05	4.40
3	7.775	7.575	52.575	4.20	4.05	4.50
5	7.775	7.575	52.575	4.20	4.05	4.50
6	7.775	7.575	52.375	4.20	4.05	4.50
7	7.775	7.625	52.375	4.20	4.05	4.50
8	7.775	7.625	52.200	4.20	4.05	4.50
9	7.775	7.575	51.700	4.20	4.05	4.50
10	7.775	7.575	51.700	4.20	4.05	4.50
12	7.775	7.575	50.500	4.20	4.05	4.50
13	7.775	7.575	49.625	4.20	4.05	4.50
14	7.775	7.575	48.750	4.20	4.05	4.50
15	7.775	7.575	48.250	4.20	4.05	4.50
16	7.775	7.625	48.750	4.20	4.05	4.50
17	7.775	7.675	49.250	4.20	4.05	4.50
19	7.775	7.675	50.125	4.20	4.05	4.50@4.60
20	8.275	7.875	50.700	4.25	4.10	4.60
21	8.275	7.925	51.000	4.30	4.15	4.60
22	8.275	8.000	50.000	4.35	4.20	4.60
23	8.275	7.975	49.750	4.35	4.20	4.60
24	8.275	7.950	49.625	4.35	4.20	4.60
26	8.275	8.000	49.500	4.35	4.20	4.60
27	8.275	8.000	49.250	4.35	4.20	4.60
28	8.275	7.950	49.250	4.35	4.20	4.60
29	8.275	7.925	49.250	4.35	4.20	4.60
30	8.275	7.925	49.125	4.35	4.20	4.60
31	8.275	7.950	49.125	4.35	4.20	4.60
Av. for month	7.979	7.738	50.463	4.254	4.104	4.535
Averages for Week						
7	7.775	7.567	52.513	4.192	4.042	4.467
14	7.775	7.583	50.746	4.200	4.050	4.500
21	7.942	7.725	49.679	4.225	4.075	4.542
28	8.275	7.979	49.563	4.350	4.200	4.600
Calendar Week Averages						
3	7.775	7.475	52.642	4.167	4.017	4.417
10	7.775	7.592	52.154	4.200	4.050	4.500
17	7.775	7.600	49.188	4.200	4.050	4.500
24	8.192	7.900	50.200	4.300	4.150	4.592
31	8.275	7.958	49.250	4.350	4.200	4.600

Silver, Gold, and Sterling Exchange New York and London

1935 Aug.	Sterling Exchange "Checks"	Sterling Exchange "90-day" Demand	Silver (c) New York	Silver London	Gold London	Gold (d) United States
1	4.95500	4.94000	67.750	30.1875	140s 9½d	$35.00
2	4.95250	4.93750	67.750	30.1875	140s10 d	35.00
3	4.95500	4.94125	67.750	30.1875	140s11 d	35.00
5	4.95500	4.94000	67.750	Holiday	Holiday	35.00
6	4.95750	4.94250	67.750	30.1875	140s 9½d	35.00
7	4.96000	4.94500	67.750	30.1875	140s 5 d	35.00
8	4.96125	4.94625	67.750	30.1875	140s 6 d	35.00
9	4.96500	4.95000	67.750	30.1875	140s 5½d	35.00
10	4.96625	4.95125	67.750	30.1875	140s 5 d	35.00
12	4.97000	4.95375	67.750	30.1250	140s 5 d	35.00
13	4.97250	4.95625	67.375	29.9375	140s 3½d	35.00
14	4.98000	4.96375	65.750	29.1875	140s 1 d	35.00
15	4.98000	4.96500	65.375	29.0000	140s 1 d	35.00
16	4.96375	4.94875	65.375	29.0000	140s 2½d	35.00
17	4.96750	4.95250	65.375	29.0625	140s 4 d	35.00
19	4.97500	4.96000	65.375	29.0000	140s 2½d	35.00
20	4.98125	4.96625	65.375	29.0000	140s 1 d	35.00
21	4.98000	4.96500	65.375	29.0000	139s11½d	35.00
22	4.97625	4.96125	65.375	29.0000	140s	35.00
23	4.96500	4.95000	65.750	29.4375	140s 1½d	35.00
24	4.97875	4.96375	65.625	29.1250	139s11½d	35.00
26	4.97625	4.96125	65.375	29.0000	139s10½d	35.00
27	4.97500	4.96125	65.375	29.0000	139s 9½d	35.00
28	4.97250	4.95875	65.375	29.0000	139s11½d	35.00
29	4.97250	4.96000	65.375	29.0000	140s	35.00
30	4.96625	4.95250	65.375	29.0000	140s	35.00
31	4.96000	4.94875	65.375	29.0000	140s 1½d	35.00
Av. for month	4.96815	.....	66.366	29.476	.....	35.00
Averages for Week						
7	4.95583	.....	67.750	.....	.....	.....
14	4.96917	.....	67.354	.....	.....	.....
21	4.97458	.....	65.375	.....	.....	.....
28	4.97396	.....	65.479	.....	.....	.....

Calender week averages: New York Silver Aug. 3d, 67.750; 10th, 67.750; 17th, 66.167; 24th, 65.479; 31st, 65.375.

The above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

Aug.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	31.8750	32.2500	35.0000	233.7500	219.2500	15.6250	15.6250	14.3125	14.5000
2	32.0625	32.4375	35.2500	233.5000	219.7500	15.5625	15.5625	14.3125	14.5000
5					Holiday				
6	32.1875	32.5625	35.5000	233.8750	215.7500	15.4375	15.5000	14.0625	14.3125
7	32.3125	32.6875	35.5000	233.7500	216.7500	15.5000	15.5000	14.1875	14.3750
8	32.1875	32.5625	35.5000	233.7500	216.2500	15.6250	15.6250	14.3750	14.5625
9	31.8750	32.2500	35.3750	228.0000	212.0000	15.5000	15.5000	14.3125	14.5000
12	32.0000	32.3750	35.2500	223.5000	209.7500	15.6250	15.6250	14.3125	14.5625
13	31.9375	32.3125	35.2500	219.0000	209.2500	15.6250	15.6875	14.3125	14.5625
14	31.8750	32.2500	35.3750	211.0000	208.5000	15.7500	15.8125	14.3125	14.5625
15	32.1250	32.5000	35.5000	208.7500	208.1250	15.7500	15.8125	14.4375	14.6875
16	32.4375	32.7500	35.5000	210.5000	209.0000	15.7500	15.7500	14.4375	14.6875
19	32.6875	33.0625	36.0000	218.7500	212.0000	15.8750	15.8750	14.8125	15.0000
20	33.1250	33.5000	36.5000	222.0000	214.5000	15.9375	16.0000	14.9375	15.1875
21	33.3750	33.7500	36.7500	225.5000	216.2500	16.1250	16.1250	15.0000	15.2500
22	33.1875	33.5625	36.5000	221.0000	214.5000	16.1250	16.1875	15.0625	15.3750
23	33.2500	33.6250	36.5000	223.0000	212.5000	16.0000	16.0000	15.0000	15.2500
26	33.7500	34.1875	37.0000	221.0000	211.0000	16.0000	16.0000	15.1250	15.3750
27	33.6250	34.0000	37.0000	220.5000	210.5000	16.0625	16.0625	15.3125	15.5625
28	33.1875	33.5625	36.7500	220.5000	210.5000	16.0000	16.0000	15.4375	15.6875
29	33.1250	33.5000	36.5000	221.2500	211.5000	15.7500	15.7500	15.5625	15.6875
30	33.3750	33.7500	37.0000	221.7500	212.0000	15.6250	15.6250	15.3750	15.5000
Av.for month	32.646	.....	35.976	222.935	.....	15.774	15.792	14.714	14.938

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(September 3, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb. — 19@21c.
Antimony, domestic or Chinese (duty paid), lb. — 12½c.
Bismuth, ton lots, lb. — 90c.
Cadmium, lb. — 70c.
Chromium, 97 per cent grade, lb. — 88c.
Nickel, electrolytic cathodes, lb. — 35c.
Magnesium, 99.8 per cent, carloads, lb. — 30c.
Palladium, troy oz. — $24.00
Platinum, (official quotation) troy oz. — $36.00
Quicksilver, flask of 76 lb., 100 flasks or more — $69.00
Radium, mg. radium content — $50.00
Selenium, 99.5 per cent, lb. — $2.00
Silicon, minimum 97 per cent, spot, lb. — 16.50c.
Tellurium, lb. — $2.00
Thallium, 100 lb. or more, lb. — $6.50
Titanium, 96 to 98 per cent, lb. — $6.00
Zirconium, commercially pure, lb. — $7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton — $30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton — $15.50@$16.50
Iron Ore, Lake Superior, long ton:
- Old Range bessemer — $4.80
- Mesabi bessemer — $4.65
- Old Range, non-bessemer — $4.65
- Mesabi, non-bessemer — $4.50

Lead (Galena) 80 per cent, Joplin, Mo., ton — $45.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:
- 52@55 per cent — 26c.
- 49@51 per cent — 25c.
- 44@47 per cent — 24c.

Molybdenum Ore, per lb. of contained MoS_2 — 42c.
Tungsten Ore, per unit of WO_3:
- Chinese duty paid — $15.00
- Domestic Scheelite — $14.50

Vanadium Ore, per lb. of contained V_2O_5 — 27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton. — $30.00

Metallic Compounds

Arsenious Oxide (arsenic) lb. — 3½c
Cobalt Oxide, 70@71 per cent, lb. — $1.39@$1.49
Copper Sulphate, 100 lb. — $3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb. — $1.24
Sodium Sulphate, bulk, ton — $13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be — $25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb. — 10c.
Ferromanganese, 78@82 per cent, gross ton — $85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained. — 95c.
Ferrosilicon, 50 per cent, gross ton — $77.50
Ferrotungsten, 75@80 per cent, lb. of W contained — $1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:
- Canadian (Quebec)
  - Crude No. 1 — $500@.....
  - Crude No. 2 — $200@$225
  - Spinning fibers — $90@$135
  - Paper stock — $32.50@$37.50
  - Shorts — $11@$14.50
- Vermont
  - Shingle stock — $47@.....
  - Paper stock — $35@.....
  - Cement stock — $23@.....

Barytes, long ton:
- Georgia, crude — $7.00
- Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron — $5.50

Bauxite, long ton:
- Domestic, chemical, 55@58 per cent — $6@ $7.50
- Domestic, abrasive, 78@84 per cent — $12.50@$15.00
- Dalmatian, 50@55 per cent — (a) $4.50@ $6.00
- French, 56@59 per cent — (a) $5.50@ $6.50

China Clay, f.o.b. mines ton:
- South Carolina and Georgia, bulk — $6.00@ $8.00
- Delaware, No. 1 — $14.00@.....

Feldspar, bulk, ton:
- Potash feldspar, 200 mesh — $17.00
- Glass-spar, white, 20 mesh — $11.75

Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton — $13.00
Fuller's earth, f.o.b. Georgia or Florida, ton — $7.00@$14.00
Magnesite, per ton:
- Dead-burned, f.o.b. California — $25.00@.....
- Dead-burned, f.o.b. Washington — $22.00@.....

Mica, per lb., North Carolina, No. 1 and 2 quality:
- 1½x2 in. — 15@30c.
- 2x2 in. — 30@50c.
- 2x3 in. — 50@65c.
- 3x4 in. — 90@ $1.25
- 4x6 in. — $1.50@ $2.50
- White, ground, 70 mesh, ton — $60.00@$80.00

Ocher, Georgia, ton — $19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports — (a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton — $16.00@$40.00
Sulphur, Texas mines, long ton — $18.00@.....
Talc, f.o.b. works, ton:
- New York, double air-floated, 325 mesh — $12.00@$15.00
- New Jersey, mineral pulp — $8.00@$10.00
- Vermont, extra white, 200 mesh — $8.50@ $9.00

Tripoli, Missouri, ton:
- 40 mesh, cream colored — $16.00@.....
- 200 mesh, cream colored — $26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:
- Bessemer — $19.00
- Basic — $18.00
- No. 2 Foundry — $18.50

Steel, base prices, Pittsburgh:
- Billets gross ton — $27.00
- Structural shapes, 100 lb. — $1.80
- Bars, 100 lb. — $1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	Silver, New York		Silver, London Spot		Sterling Exchange "Checks"	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	59.048	20.278	27.380	509.259	477.635
April	45.180	67.788	19.740	30.986	515.210	483.596
May	44.226	74.356	19.276	33.865	510.510	488.587
June	45.173	71.940	19.981	32.346	504.721	493.245
July	46.310	68.216	20.512	30.500	503.990	495.558
August	48.986	66.366	21.377	29.476	506.398	496.815
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery, Electrolytic, Domestic		F.O.B. Refinery, Electrolytic, Export	London Spot, Standard		London Spot, (a) Electrolytic	
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March	7.775	8.775	6.526	32.497	28.518	35.512	31.607
April	8.173	8.775	7.328	33.006	31.231	36.038	34.763
May	8.275	8.775	7.794	32.662	33.344	35.756	36.733
June	8.594	8.634	7.307	32.149	30.799	35.339	34.039
July	8.775	7.775	7.350	29.707	31.024	32.778	34.261
August	8.775	7.979	7.738	28.358	32.646	31.483	35.976
September	8.775	....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March	4.000	3.579	3.900	3.429	11.545	11.842	11.012	11.188
April	4.179	3.692	4.042	3.542	11.500	11.794	12.231	12.459
May	4.140	3.962	3.990	3.812	11.051	11.341	13.861	13.940
June	3.975	4.020	3.825	3.870	11.054	11.253	13.776	13.806
July	3.772	4.123	3.623	3.973	10.813	11.045	14.451	14.511
August	3.747	4.254	3.597	4.104	10.821	11.028	15.774	15.792
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits, New York		Standard, Spot, London	
	1934	1935	1934	1935
January	51.891	50.916	226.631	231.193
February	51.668	50.063	226.731	227.381
March	53.838	46.962	233.863	215.726
April	55.622	50.154	239.181	223.513
May	53.541	51.138	234.239	227.602
June	51.271	51.108	226.875	227.586
July	51.930	52.297	230.381	232.397
August	51.953	50.463	228.114	222.935
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	3.714	14.844	15.125	11.819	12.000
March	4.368	3.894	14.735	15.033	12.095	12.250
April	4.370	4.030	14.916	15.200	12.891	13.128
May	4.346	4.220	14.722	14.966	14.534	14.685
June	4.240	4.299	14.241	14.467	13.734	13.898
July	4.317	4.325	13.466	13.693	14.065	14.185
August	4.281	4.535	13.682	13.756	14.714	14.938
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	55.000	23.300	20.000
March	55.000	58.462	23.300	20.000
April	55.000	65.000	23.300	20.000
May	55.000	65.000	23.300	20.000
June	55.000	65.000	23.300	20.000
July	55.000	65.000	23.300	20.000
August	55.000	70.000	23.300	20.000
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	14.250	72.011	72.500	38.000	34.000
March	7.545	14.250	75.472	72.500	38.000	32.846
April	7.918	14.029	75.930	72.500	38.000	32.000
May	8.465	12.712	75.577	72.135	36.538	32.000
June	7.900	12.500	75.000	71.460	36.000	32.000
July	8.024	12.500	75.000	70.538	36.000	32.000
August	8.514	12.500	75.000	69.000	36.000	31.333
September	8.745	.....	74.563	.....	35.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	19.00	17.00	18.00	17.50	18.50
March	18.00	19.00	17.00	18.00	17.50	18.50
April	18.48	19.00	17.48	18.00	17.98	18.50
May	19.00	19.00	18.00	18.00	18.50	18.50
June	19.00	19.00	18.00	18.00	18.50	18.50
July	19.00	19.00	18.00	18.00	19.50	18.50
August	19.00	19.00	18.00	18.00	18.50	18.50
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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WILLARD CHEVALIER
Vice-President

Aviation in the mining industry will be the subject of extensive treatment in the November number of *E.&M.J.* Geological reconnaissance, surveying, mapping, prospecting, transport of men, materials, and minerals—all will be treated in a comprehensive, world-wide coverage of the subject. The mining industry is conspicuous for its use of the airplane as an aid to ground work—more so than any other single industry. The next issue of *E.&M.J.* will present for the first time a correlated picture of the new tools made available to the mining industry by the progress in aviation and aerial photography. New techniques are being developed on which every mining engineer ought to be well informed.

●

Eighteen Industries that were undeveloped in 1879 gave employment to 1,123,314 workers 50 years later, according to figures compiled by the National Industrial Conference Board. Motor vehicles, rubber tires, gasoline, rayon, aircraft, aluminum manufactures, and motion-picture apparatus are some of the conspicuous examples. The average number of wage earners employed by the eighteen industries in 1929 constituted two-fifths of the increase in industrial employment in proportion to population during the 50-year period, indicating the magnitude of the contribution of invention and scientific research in opening new avenues of employment and broadening national consuming power.

●

A Jet-Black Brick is being manufactured by the Auburn Shale Company, of Auburn, Pa. The finish is rough texture or smooth face and the color is said to be unaffected by acids, fire, alkalies, or the weather.

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Silver Storage. Because the Government money vaults in Philadelphia are getting crowded, the Treasury is moving $25,000,000 in silver dollars to Washington, where there is still plenty of room. The coins are packed loosely in sealed canvas sacks, each of which contains $1,000 and weighs 59 pounds, the entire shipment amounting to well over 700 tons. Transportation is easy; the money is simply mailed under government frank, so that the Post Office does the worrying. Checking is done by weighing. If a bag weighs light, the coins are counted. No numerical shortage has been found in counting the contents of 1,500 sacks, but several Mexican and other foreign coins were discovered.

●

Seigniorage. When the Government mints a coin it automatically takes a profit which is the difference between the value of the metal and its value as a coin. Under this Administration's silver rehabilitation program the Treasury has netted such a profit of nearly a quarter of a million dollars. Treasury officials estimate that, from the beginning of our Government, the Treasury has derived a profit of nearly $600,000,000 from seigniorage.

●

Investment in Safety. Houses equipped with lightning rods, according to *American Architect* for August, are almost as rare today as the cross-country store, yet the damage due to lightning and lightning fires is estimated at $20,000,000 annually. The National Fire Protective Association declares that the only safe buildings are those with metal-frame construction and well-grounded all-metal buildings. Civilized man need not live in firetraps. Indifference to safety is just a bad habit.

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Don't let inertia encumber your business

BUSINESS philosophy associates "inertia" with the ever-debatable policy of "Let well enough alone." Too often this inertia is the result of a groundless fear of upsetting routine, changing specifications and inspection standards, resetting machines, recasting work sheets, ironing out new processing kinks . . . temporarily slowing up production.

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